

# PATENT APPLICATION TRANSMITTAL LETTER

Docket Number (Optional)

To the Commissioner of Patents and Trademarks:

Transmitted herewith for filing under 35 U.S.C. 111(a) and 37 CFR 1.53(b)(1) is the patent application of

Victor Jay Liechty II

entitled Penetration Enhancing Aerodynamically Favorable Arrowhead.

Enclosed are:

- ☒ 47 pages of written description, claims and abstract.
- ☒ 29 sheets of drawings.
- ☐ an assignment of the invention to \_\_\_\_\_
- ☒ executed declaration of the inventors.
- ☐ a certified copy of a \_\_\_\_\_ application.
- ☐ associate power of attorney.
- ☒ a verified statement to establish small entity status under 37 CFR 1.9 and 1.27.
- ☐ information disclosure statement
- ☐ preliminary amendment
- ☒ other: Certificate of Deposit

## CLAIMS AS FILED

	NUMBER FILED	NUMBER EXTRA	RATE	FEE
BASIC FEE (37 CFR 1.16(a))			\$	\$ 375 <sup>00</sup>
TOTAL CLAIMS (37 CFR 1.16(c))	59 - 20 =	* 39	x \$ 9 <sup>00</sup>	351 <sup>00</sup>
INDEPENDENT CLAIMS (37 CFR 1.16(b))	5 - 3 =	* 2	x \$ 39 <sup>00</sup>	78 <sup>00</sup>
MULTIPLE DEPENDENT CLAIM PRESENT	(37 CFR 1.16(d))		\$	
* NUMBER EXTRA MUST BE ZERO OR LARGER			TOTAL	\$ 804 <sup>00</sup>
If applicant has small entity status under 37 CFR 1.9 and 1.27, then divide total fee by 2, and enter amount here.			SMALL ENTITY TOTAL	\$ 804 <sup>00</sup>

- ☐ A check in the amount of \$ \_\_\_\_\_ to cover the filing fee is enclosed.
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  - ☐ Charge the issue fee set in 37 CFR 1.18 at the mailing of the Notice of Allowance, pursuant to 37 CFR 1.311(b).

May 28, 1999  
 Date

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**VERIFIED STATEMENT CLAIMING SMALL ENTITY STATUS  
(37 CFR 1.9(f) & 1.27(b))--INDEPENDENT INVENTOR**

Docket Number (Optional)

Applicant or Patentee: Victor Jay Liechty II

Serial or Patent No.: \_\_\_\_\_

Filed or Issued: \_\_\_\_\_

Title: Penetration Enhancing Aerodynamically Favorable Arrowhead

As a below named inventor, I hereby declare that I qualify as an independent inventor as defined in 37 CFR 1.9(c) for purposes of paying reduced fees to the Patent and Trademark Office described in:

- ☐ the specification filed herewith with title as listed above.  
☒ the application identified above.  
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I have not assigned, granted, conveyed or licensed and am under no obligation under contract or law to assign, grant, convey or license, any rights in the invention to any person who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

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Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

Victor Jay Liechty II

NAME OF INVENTOR

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Date

Date

Date

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Patent Application of

Victor Jay Liechty II

for

**PENETRATION ENHANCING AERODYNAMICALLY FAVORABLE ARROWHEAD.**

## **BACKGROUND - FIELD OF THE INVENTION**

This invention relates generally to arrowheads, and more particularly to aerodynamically favorable arrowheads such as pivotal blade arrowheads and blade-opening arrowheads that have a sharp cutting edge located upon their arrowhead bodies at a location forward of a corresponding main cutting blade cutting edge when in a penetrating configuration such that each arrowhead cuts target material in front of a corresponding main cutting blade when penetrating a target so as to eliminate the frictional drag that the otherwise dull arrowhead bodies would generate with the target before the main cutting blades began cutting target material thereinfroont.

This application is a continuation in part of my U.S. Patent Application Serial No. 09 / 082 636 filed May 21, 1998, which is incorporated herein by specific reference.

## **BACKGROUND - DESCRIPTION OF PRIOR ART**

Arrows have long been used for war, hunting and competitive sports. A conventional arrow has a shaft, a nock at one end that receives the bow string, an arrowhead or point that attaches to the opposite end, and fletchings. The fletchings are glued to the shaft near the nock end, and help to stabilize the arrow in flight by causing it to rotate. Arrowheads generally have a pointed forward end, and an opposite threaded shaft end that attaches the arrowhead to the arrow shaft. Arrowheads are also attached to the forward end of arrow shafts by glueing and other methods.

Arrowheads come in a variety of different sizes and configurations depending on their intended use. For example, there are specifically designed arrowheads for competitive target shooting, shooting fish, hunting birds or small game animals, and for hunting big game animals.

Arrowheads used for hunting kill the game animal by cutting vital organs such as the lungs and vascular vessels such as arteries, which causes rapid hemorrhaging and/or suffocation. Quick and humane kills are dependent on accurate shot placement, and upon the amount or volume of the animal tissue that is cut. Hunting arrowheads that cut more tissue are more lethal, and therefore are better. The volume of tissue that is cut is determined by the cutting diameter of the arrowhead, the number of blades it contains, and by the distance the arrowhead penetrates into the animal. The cutting diameter of an arrowhead is determined by how far each cutting blade extends outward from the arrowhead body. The further the blades extend outward the larger the cutting diameter is, and therefore the more cutting potential the arrowhead has.

A common type of arrowhead used in hunting is the fixed-blade arrowhead, which has a pointed tip end used for penetrating, and generally triangular shaped fixed-blades or non-pivotal blades that each have a razor sharp edge for cutting. Conventional fixed-blade arrowheads blades are held in a fixed position on the arrowhead, and most such blades are replaceable. The replaceable blades attach to the arrowhead body in longitudinal grooves called blade slots. The tip of the arrowhead may be separably attachable to the arrowhead body or may be integral with it.

Arrowheads for hunting are generally known as broadheads.

Another popular type of arrowhead for hunting is the blade-opening arrowhead. Blade-opening arrowheads are generally known as mechanical broadheads. Blade-opening arrowheads, like conventional fixed-blade arrowheads generally have an elongate arrowhead body, a tip end, and a threaded opposite end. The blades of blade-opening arrowheads have an attachment end which attaches the blades to the arrowhead body by a pivot pin, so that the blades can pivot or rotate in a plane between a closed position and an open position. Blade-opening arrowhead blades are generally an elongate substantially rectangular shape and also have a free non-attached end situated opposite the attachment end. The blades of blade-opening arrowheads are also received in blade slots, which are machined or formed into the side of the arrowhead body. When the pivotal blades of blade-opening arrowheads are retracted or folded into the closed position, a substantial majority of each blade is generally housed within its corresponding blade slot. This feature gives blade-opening arrowheads the ability to attain significantly increased aerodynamic performance over fixed-blade arrowheads, due to the significantly decreased exposure the retracted blades have with the air when the arrow is rotating while in flight. Such increased aerodynamic performance results in the desirable features of: faster shooting arrows, flatter arrow trajectories, increased penetration energy and enhanced repeatability of accuracy, while also providing a wide diameter cut in the game animal when the razor sharp blades open at impact with the animal.

Yet another type of arrowhead used for hunting has pivotal blades that are exposed at a full cutting diameter position while the arrowhead is in-flight. Such arrowheads also generally achieve better aerodynamic performance than fixed-blade arrowheads because by design each pivotal blade only attaches to a corresponding arrowhead body at a single location which therefore with the substantially elongate rectangular shaped blades provides arrowheads having significantly decreased blade surface area exposure with the air while the arrow is in-flight.

It is desirable for an arrowhead to penetrate as deep in the game animal as possible for maximum lethality. The less friction or drag the arrowhead generates or experiences while penetrating a target the further it will penetrate therethrough. The razor sharp cutting edges of arrowheads blades greatly reduce arrowhead penetration friction by slicing with their keen edges.

A major problem associated with conventional pivotal blade arrowheads such as blade-

opening arrowheads is that when in a penetrating or open position such arrowheads do not have a sharp cutting edge exposed from their arrowhead bodies for a considerable amount of their length rearward of the forward leading tip end thereof. This creates a significantly dull forward section of an arrowhead body, which therefore must be pushed or wedged into the target the distance from the leading tip end of the respective arrowhead to the cutting blade before the arrowhead does any cutting. Such a design generates an enormous amount of friction between the dull arrowhead body and target material which unnecessarily and quickly depletes kinetic energy that could of otherwise aided in further target penetration and therefore enhanced lethality.

It is apparent that there is a need for a pivotal blade arrowhead such as a blade-opening arrowhead that when in an penetrating position has a sharp cutting edge exposed at a location forward of the pivotal blade cutting edge so as to slice or cut target material ahead of the pivotal blade and to therefore reduce the friction and drag of the arrowhead while penetrating a target such that both penetration and lethality are maximized.

## SUMMARY OF THE INVENTION

It is an object of the present invention to provide an aerodynamically favorable arrowhead such as a pivotal blade arrowhead that when in a penetrating configuration has at least a section of a sharp cutting edge exposed at a location forward of a main blade cutting edge so as to slice or cut target material ahead of the main cutting blade and to therefore reduce the friction and drag of the arrowhead while penetrating a target such that both penetration and lethality are maximized.

It is another object of the present invention to provide an aerodynamically favorable blade-opening arrowhead that when in a penetrating configuration has at least a section of a sharp cutting edge exposed at a location forward of the pivotal blade cutting edge so as to slice or cut target material ahead of the pivotal blade and to therefore reduce the friction and drag of the arrowhead while penetrating a target such that both penetration and lethality are maximized.

It is still another object of the present invention to provide an aerodynamically favorable arrowhead having a pivotal blade and a fixed-blade such that when in a penetrating configuration at least a section of the sharp cutting edge of the fixed-blade is exposed at a location forward of the pivotal blade cutting edge so as to slice or cut target material ahead of the pivotal blade and to therefore reduce the friction and drag of the arrowhead while penetrating a target such that both penetration and lethality are maximized.

It is yet still another object of the present invention to provide an arrowhead having a pivotal blade and an integral cutting protrusion with a sharp cutting edge exposed thereon such that when in a penetrating configuration at least a section of the sharp cutting edge of the integral cutting protrusion is situated forward of the pivotal blade cutting edge so as to slice or cut target material ahead of the pivotal blade and to therefore reduce the friction and drag of the arrowhead while penetrating a target such that both penetration and lethality are maximized.

It is yet still further another object of the present invention to provide an aerodynamically favorable arrowhead such as a pivotal blade arrowhead that when in a penetrating configuration has an arrowhead body with at least a section of a sharp cutting edge exposed therefrom so as to be located forward of a main blade cutting edge and to slice or cut target material ahead of the main cutting blade and to therefore reduce the friction and drag of the arrowhead while penetrating a target such that both penetration and lethality are maximized.

The foregoing objects and advantages and other objects and advantages of the present invention are accomplished as according to some of the preferred embodiments of this invention with hunting arrowheads that attach to the forward end of an arrow shaft, where a plurality of blades are pivotally connected to an arrowhead body. When the blades are in a penetrating configuration a plurality of razor sharp cutting edges are exposed at a location upon corresponding arrowhead bodies forward of the pivotal blade cutting edges so as to slice or cut target material ahead of the pivotal blades and to therefore reduce the friction and drag of the arrowhead while penetrating a target such that both penetration and lethality are maximized.

Such an arrowhead as according to one preferred embodiment of this invention is a blade-opening arrowhead that has a fixed-blade removably attachable with its arrowhead body, such that when attached thereto at least a section of the cutting edge of the fixed-blade is situated forward of the cutting edge of a corresponding pivotal blade when the arrowhead is in a penetrating configuration. When the arrowhead is in an in-flight configuration the furthest perpendicular distance from the central longitudinal axis of the arrowhead body to the cutting edge of the fixed-blade is less than the perpendicular distance from the central longitudinal axis of the arrowhead body to the furthest section of the pivotal blade from the central longitudinal axis. Such an arrowhead provides the excellent favorable aerodynamics inherent with blade-opening arrowheads while providing greatly enhanced penetration over conventional blade-opening arrowheads by cutting target material ahead of the pivotal cutting blades and thereby reducing the friction and drag that otherwise would of been generated between the arrowhead body and the target material.

Some arrowhead preferred embodiments as according to this invention having fixed-blades exposed from corresponding arrowhead bodies have substantially flat or planar fixed-blades while other such preferred arrowhead embodiments as according to this invention have fixed-blades with bent portions which aid in their attachment or securement to corresponding arrowhead bodies.

Some arrowhead preferred embodiments as according to this invention having fixed-blades exposed from corresponding arrowhead bodies have substantially removably attachable fixed-blades whereas other such preferred arrowhead embodiments as according to this invention have fixed-blades integral with corresponding arrowhead bodies that are substantially non-removably attached by welding or other similar techniques to their corresponding arrowhead bodies.



Other arrowhead preferred embodiments as according to this invention having at least a section of a cutting edge exposed from corresponding arrowhead bodies at a location forward of the cutting edge of a corresponding main cutting blade when the arrowhead is in a penetrating configuration have at least a linear section of each such cutting edge substantially in coplanar alignment with each other when the arrowhead is in a penetrating configuration whereas other preferred arrowhead embodiments as according to this invention do not.

Yet other arrowhead preferred embodiments as according to this invention have arrowhead bodies that each have at least one integral cutting protrusion formed therewith. Each integral cutting protrusion has a sharp cutting edge exposed thereon such that when the arrowhead is in a penetrating configuration at least a section of the integral cutting protrusion sharp cutting edge is situated forward of the main blade cutting edge. Such designs also provide arrowheads that slice or cut target material ahead of the pivotal blade and therefore reduce the friction and drag of the arrowhead while penetrating a target so as to be an improvement over the prior art.

Still other arrowhead preferred embodiments as according to this invention have pivotal blades that are exposed at a maximum cutting diameter when the arrowheads are in an in-flight configuration. Some such arrowheads are non-blade opening arrowheads whereas some such others are blade-opening arrowheads.

The arrowheads as according to the desired results and scope of this invention are more lethal than prior art conventional arrowheads in that they cut target material ahead of or in front of the arrowhead main cutting blades and therefore reduce the friction and drag of the arrowhead that otherwise would of been generated between the arrowhead body and the target material while penetrating a target such that both penetration and lethality are maximized.

As has been shown in the above discussion, the arrowheads according to this invention overcome deficiencies inherent in prior art arrowheads.

With the above objects and advantages in view, other objects and advantages of the invention will more readily appear as the nature of the invention is better understood, the invention is comprised in the novel construction, combination and assembly of parts hereinafter more fully described, illustrated, and claimed.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partial sectioned side view of an arrowhead as according to this invention;  
FIG. 2 is a cross-sectional view of the arrowhead as illustrated in FIG. 1;  
FIG. 3 is a side view of an arrowhead tip as according to this invention;  
FIG. 4 is a side view of another arrowhead tip as according to this invention;  
FIG. 5 is a side view of an arrowhead tip coupler as according to this invention;  
FIG. 6 is a side view of an arrowhead cutting blade as according to this invention;  
FIG. 7 is a side view of an arrowhead cutting blade as according to this invention;  
FIG. 8 is another partial sectioned side view of the arrowhead as according to this invention as illustrated in FIG. 1;  
FIG. 9 is a cross-sectional view of another arrowhead as according to this invention;  
FIG. 10 is a partial sectioned side view of an arrowhead as according to this invention;  
FIG. 11 is a cross-sectional view of the arrowhead as illustrated in FIG. 10;  
FIG. 12 is a partial length side view of another arrowhead as according to this invention;  
FIG. 13 is a cross-sectional view of the arrowhead body of the arrowhead as illustrated in FIG. 12;  
FIG. 14 is a partial length side view of another arrowhead as according to this invention;  
FIG. 15 is another partial length side view of the arrowhead as illustrated in FIG. 14;  
FIG. 16 is a cross-sectional view of the arrowhead as illustrated in FIG. 15;  
FIG. 17 is a partial length side view of another arrowhead as according to this invention;  
FIG. 18 is another partial length side view of the arrowhead as illustrated in FIG. 17;  
FIG. 19 is a cross-sectional view of the arrowhead as illustrated in FIG. 18;  
FIGS. 20 & 21 are cross-sectional views of other arrowheads as according to this invention;  
FIG. 22 is a partial length partial sectioned side view of another arrowhead of this invention;  
FIG. 23 is a top view of an annular ring as according to this invention;  
FIG. 24 is a side view of an arrowhead cutting blade as according to this invention;  
FIG. 25 is a partial length partial sectioned side view of another arrowhead of this invention;  
FIG. 26 is a side view of a set screw as according to this invention;  
FIG. 27 is a side view of a set screw as according to this invention;

FIG. 28 is a partial length partial sectioned side view of another arrowhead of this invention;  
 FIG. 29 is a side view of an arrowhead tip as according to this invention;  
 FIG. 30 is a side view of an arrowhead cutting blade and a set screw as according to this invention;  
 FIG. 31 is a side view of an arrowhead cutting blade as according to this invention;  
 FIG. 32 is a partial sectioned side view of an arrowhead as according to this invention;  
 FIG. 33 is a side view of a set screw as according to this invention;  
 FIG. 34 is a side view of a set screw as according to this invention;  
 FIG. 35 is a partial sectioned side view of an arrowhead as according to this invention;  
 FIG. 36 is a side view of an arrowhead cutting blade and set screws as according to this invention;  
 FIG. 37 is a side view of an arrowhead cutting blade as according to this invention;  
 FIG. 38 is a side view of an arrowhead cutting blade as according to this invention;  
 FIG. 39 is a side view of an arrowhead cutting blade as according to this invention;  
 FIG. 40 is a partial sectioned side view of an arrowhead as according to this invention;  
 FIG. 41 is a side view of a set screw as according to this invention;  
 FIG. 42 is a side view of a set screw as according to this invention;  
 FIG. 43 is a side view of an arrowhead cutting blade and a set screw as according to this invention;  
 FIG. 44 is a partial sectioned side view of an arrowhead as according to this invention;  
 FIG. 45 is a partial sectioned side view of an arrowhead as according to this invention;  
 FIG. 46 is a side view of an arrowhead cutting blade and a set screw as according to this invention;  
 FIG. 47 is a partial sectioned side view of an arrowhead as according to this invention;  
 FIG. 48 is a partial sectioned side view of an arrowhead as according to this invention;  
 FIG. 49 is a cross-sectional view of the arrowhead as illustrated in FIG. 48;  
 FIG. 50 is a cross-sectional view of the arrowhead body as illustrated in FIG. 48;  
 FIG. 51 is a side view of an arrowhead cutting blade as according to this invention;  
 FIG. 52 is a cross-sectional view of the cutting blade as illustrated in FIG. 51;  
 FIG. 53 is a side view of an arrowhead tip as according to this invention;  
 FIG. 54 is an enlarged perspective view of the arrowhead cutting blade of FIGS. 51 & 52;  
 FIG. 55 is a cross-sectional view an arrowhead as according to this invention;  
 FIG. 56 is a cross-sectional view of a cutting blade of the arrowhead as illustrated in FIG. 55;

FIG. 57 is a cross-sectional view of the arrowhead body of the arrowhead as illustrated in FIG. 55;  
FIG. 58 is a cross-sectional view an arrowhead as according to this invention;  
FIG. 59 is a cross-sectional view of a cutting blade of the arrowhead as illustrated in FIG. 58;  
FIG. 60 is a cross-sectional view of the arrowhead body of the arrowhead as illustrated in FIG. 58;  
FIG. 61 is a cross-sectional view an arrowhead as according to this invention;  
FIG. 62 is a cross-sectional view of a cutting blade of the arrowhead as illustrated in FIG. 61;  
FIG. 63 is a cross-sectional view of the arrowhead body of the arrowhead as illustrated in FIG. 61;  
FIG. 64 is a partial sectioned side view of an arrowhead as according to this invention;  
FIG. 65 is a side view of an arrowhead tip as according to this invention;  
FIG. 66 is a cross-sectional view and a side view of a cutting blade as according to this invention;  
FIG. 67 is a partial section partial length side view of an arrowhead as according to this invention;  
FIG. 68 is a cross-sectional view the arrowhead as illustrated in FIG. 64;  
FIG. 69 is a cross-sectional view of the arrowhead body of the arrowhead as illustrated in FIG. 64;  
FIGS. 70-75 are cross-sectional views of other arrowheads as according to this invention;  
FIG. 76 is a partial sectioned side view of an arrowhead as according to this invention;  
FIGS. 77&78 are exploded partial section partial length side views of an arrowhead as according to this invention;  
FIG. 79 is a cross-sectional view of the arrowhead as illustrated in FIG. 76;  
FIG. 80 is a cross-sectional view of the arrowhead body of the arrowhead as illustrated in FIG. 76;  
FIGS. 81 & 82 are a cross-sectional view and a side view of a cutting blade as according to this invention;  
FIGS. 82-85 are cross-sectional views of other arrowheads as according to this invention;  
FIG. 86 is a partial sectioned side view of an arrowhead as according to this invention;  
FIG. 87 is an exploded partial sectioned side view of the arrowhead as illustrated in FIG. 86;  
FIG. 88 is an exploded partial length side view of an arrowhead as according to this invention;  
FIG. 89 is a side view of a cutting blade as according to this invention;  
FIG. 90 is a partial sectioned side view of an arrowhead as according to this invention;  
FIG. 91 is a top view of an arrowhead as according to this invention;  
FIG. 92 is a cross-sectional view of the arrowhead tip of the arrowhead as illustrated in FIG. 91;

FIG. 93 is a top view of an arrowhead as according to this invention;  
FIG. 94 is a cross-sectional view of the arrowhead tip of the arrowhead as illustrated in FIG. 93;  
FIG. 95 is a cross-sectional view of an arrowhead tip as according to this invention;  
FIG. 96 is a top view of an arrowhead as according to this invention;  
FIG. 97 is a cross-sectional view of the arrowhead tip of the arrowhead as illustrated in FIG. 96;  
FIG. 98 is a top view of an arrowhead as according to this invention;  
FIG. 99 is a cross-sectional view of the arrowhead tip of the arrowhead as illustrated in FIG. 98;  
FIGS. 100-102 are top views of arrowheads as according to this invention;  
FIGS. 103-105 are cross-sectional views of arrowhead tips as according to this invention;  
FIG. 106 is a partial sectioned side view of an arrowhead as according to this invention;  
FIG. 107 is a side view of an arrowhead tip as according to this invention;  
FIG. 108 is a side view of a cutting blade as according to this invention;  
FIG. 109 is a side view of an arrowhead cutting blade and a set screw as according to this invention;  
FIG. 110 is a cross-sectional view of an arrowhead body as according to this invention;  
FIG. 111 is a cross-sectional view of an arrowhead as according to this invention;  
FIG. 112 is a side view of a cutting blade as according to this invention;  
FIG. 113 is a side view of an arrowhead tip as according to this invention;  
FIG. 114 is a cross-sectional view of an arrowhead as according to this invention;  
FIG. 115 is a side view of a cutting blade as according to this invention;  
FIG. 116 is a partial sectioned side view of an arrowhead as according to this invention;  
FIGS. 117-121 are side views of cutting blades as according to this invention;  
FIG. 122 is a side view of a set screw as according to this invention;  
FIG. 123 is a cross-sectional view of an arrowhead as according to this invention;  
FIG. 124 & 125 are side views of cutting blades as according to this invention;  
FIG. 126 is a cross-sectional view of an arrowhead as according to this invention;  
FIG. 127 & 128 are side views of cutting blades as according to this invention;  
FIG. 129 is a partial sectioned side view of an arrowhead as according to this invention;  
FIG. 130 is a partial sectioned side view of an arrowhead as according to this invention;  
FIG. 131 is a partial sectioned side view of an arrowhead as according to this invention;

FIGS. 132 & 133 are side views of cutting blades as according to this invention;  
 FIGS. 134 & 135 are side views of set screws as according to this invention ;  
 FIG. 136 is a side view of a cutting blade as according to this invention;  
 FIG. 137 is a top view of an annular ring as according to this invention;  
 FIG. 138 is a cross-sectional view of an arrowhead as according to this invention;  
 FIG. 139 is a side view of a cutting blade as according to this invention;  
 FIG. 140 is a cross-sectional view of an arrowhead as according to this invention;  
 FIG. 141 is a side view of a cutting blade as according to this invention;  
 FIGS. 142-149 are partial sectioned side views of arrowheads as according to this invention;  
 FIG. 150 is a cross-sectional view of the arrowhead as illustrated in FIG. 149;  
 FIGS. 151-162 are cross-sectional views of arrowheads as according to this invention;  
 FIG. 163 is a partial sectioned side view of an arrowhead as according to this invention;  
 FIG. 164 is a cross-sectional view of the arrowhead as illustrated in FIG. 163;  
 FIGS. 165-180 are cross-sectional views of arrowheads as according to this invention;  
 FIG. 181 is a partial sectioned side view of an arrowhead as according to this invention;  
 FIG. 182 is a cross-sectional view of the arrowhead as illustrated in FIG. 181;  
 FIG. 183 is a partial sectioned side view of an arrowhead as according to this invention;  
 FIG. 184 is a cross-sectional view of the arrowhead as illustrated in FIG. 183;  
 FIG. 185 is a partial sectioned side view of an arrowhead as according to this invention;  
 FIG. 186 is a cross-sectional view of the arrowhead as illustrated in FIG. 185;  
 FIGS. 187-193 are cross-sectional views of arrowheads as according to this invention;  
 FIG. 194 is a partial sectioned side view of an arrowhead as according to this invention; and  
 FIG. 195 is a cross-sectional view of the arrowhead as illustrated in FIG. 194.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIGS. 1-8 illustrate a blade-opening arrowhead **200** as according to one preferred embodiment of this invention. Arrowhead **200** has a forward leading end **1090**, a plurality of three pivotal cutting blades **900** and a plurality of three fixed cutting blades **300**. Each fixed cutting blade **300** has a cutting edge **400** that is substantially in coplanar alignment with a cutting edge **950** of a corresponding pivotal blade **900** when arrowhead **200** is in a penetrating configuration, as is illustrated in FIG. 1. As is also illustrated in FIG. 1 each cutting edge **400** is not in collinear orientation or alignment with a corresponding cutting edge **950** that it is coplanar with. Each cutting edge **950** has a pair of grind bevels **952** such as is first ground on cutting blades in a strip grinding process as is well known to those skilled in the art. It is apparent that grind bevels **952** may have hone bevels as well, such as substantially convex hone bevels as is attainable with frustuconical grinding wheels. As also illustrated in FIG. 1 cutting edges **400** of blades **300** are located rearward of leading forward end **1090** of arrowhead **200**.

Arrowhead **200** has a removably attachable arrowhead tip **800** that has a plurality of three facets **850**, and a plurality of three facet boundary cutting edges **870** each of which is also substantially in coplanar alignment with both a corresponding cutting edge **400** and a corresponding cutting edge **950** when arrowhead **200** is in a penetrating configuration. Arrowhead tip **800** is preferably a hollow ground trocar tip or chisel type bone-splitting tip as is well known in the industry. It is apparent that facets **850** may be substantially convex or flat. Although arrowhead tip **800** is depicted as having a greatest cross-sectional diameter that is not wider than the cross-sectional diameter of an arrowhead body **600** where the rear end of tip **800** abuts thereagainst when the arrowhead is assembled, it is apparent that the arrowhead tips as according to this invention may have greatest cross-sectional diameters that are wider than the cross-sectional diameter of an accompanying arrowhead body at which the rear end of such a tip abuts thereagainst or adjoins therewith. Such wider arrowhead tip greatest cross-sectional diameters may be found in a barrel section of the arrowhead tip and/or in a facet region thereof. It is apparent that such wider diameter or cross-sectional arrowhead tips may be integral with their corresponding arrowhead bodies.





a location closer to forward leading end 1090 than to arrowshaft contacting surface 1080. Each pivotal blade 900 has a wing 970 that extends therefrom in a direction outwardly from arrowhead body 600 when arrowhead 200 is in an in-flight or closed retracted configuration as is illustrated in FIG. 8. Wings 970 serve to increase the moment-arm for levering blades 900 from their folded-up closed position when beginning to rotate towards an open position.

It is apparent that arrowhead 200 or other arrowheads as according to this invention could be shot from an archery bow when in an open position such as is depicted in FIG. 1 so as to simultaneously achieve both the favorable aerodynamic and enhanced penetration desired results as according to this invention. Such performance objectives are achievable with an arrowhead similar to arrowhead 200 since pivotal blades 900 have a relatively minor exposed surface area when in an open configuration, as compared to that of conventional fixed-blade arrowhead blades. Thus when shot in an open position such pivotal blade arrowheads as according to this invention would have accurate and favorable flight characteristics like unto other non blade-opening pivotal blade arrowheads, as is known to those skilled in the art, while also achieving improved penetration over prior art conventional arrowheads.

Although not specifically illustrated in this specification, it is apparent that the various elements, designs and functional objective results of the arrowheads as according to this invention and of those arrowheads incorporated herein by specific reference are applicable to blade-opening arrowheads whose blades rotate in a forward direction -toward the forward leading end of the arrowhead- when rotating to an open position or a penetrating configuration upon impact of a target or application of an opening force. For example, such arrowheads as that which have plunger shafts, wedging cams and/or other components that have movement in an axial or elongate direction relative to an accompanying arrowshaft, or other arrowhead components whether attached directly to a cutting blade or not, are within the scope of the arrowheads as according to this invention. As a specific example, a wedge cam with a tip end exposed from an accompanying arrowhead body when such an arrowhead is in a penetrating configuration could have a cutting blade or cutting edge such as cutting edge 400 thereon so as to cut target material in front of a main arrowhead cutting blade and to therefore achieve the increased penetration and reduced frictional drag desired results of this invention.

FIGS. 1- 3 & 6 illustrate in detail how fixed-blades 300 are removably attached to arrowhead 200. Arrowhead body 600 of arrowhead 200 has a blade slot 750 for each pivotal blade 900, a blade slot 700 for each fixed-blade 300, an internal leg cavity 686, an internal threaded cylinder or bore 674 and a washer 670. Each fixed-blade 300 has a pair of grind bevels 402-402 (which may also comprise hone bevels as is known to those skilled in the art), a pair of opposing substantially parallel side surfaces or faces 406, a leg 404 and a forward locking end 408. In addition to facets 850 arrowhead tip 800 has a shaft 830, an undercut locking surface 843 and an undercut locking cavity 842. Each fixed-blade 300 is placed in its corresponding slot 700 such that when arrowhead tip 800 is screwed into arrowhead body 600 locking ends 408 of blades 300 seat into undercut locking cavity 842 and abut against undercut locking surface 843 and against shaft 830 of arrowhead tip 800 which firmly attaches blades 300 to arrowhead 200.

It is apparent that the method and/or manners of attaching or providing a friction reducing forward leading cutting edge or a penetration enhancing cutting edge such as a cutting edge 400 to or with the arrowheads of this invention is of relatively minor importance to the scope of this invention. As will become apparent from this specification and its parent patent application incorporated herein by specific reference there are many and various suitable manners to provide a cutting edge that is configured such upon its corresponding arrowhead body so as to cut target material in front of a main arrowhead cutting blade such as a pivotal blade of a blade-opening arrowhead so as to achieve the increased penetration and reduced frictional drag desired results of this invention. Therefore, it is apparent that any method or the like for providing an arrowhead with a cutting edge that achieves the objectives and desired results of this invention is within the scope of this invention.

As illustrated in FIG. 1 arrowhead 200 has an annular blade ring 1000 which hingedly or pivotally connects each blade 900 to arrowhead body 600, an annular notch ring 1020 and an annular compression spring 1030. Annular compression spring 1030 urges annular ring 1020 into a second notch of each blade 900 when arrowhead 200 is in an open or penetrating configuration such as FIG. 1 depicts. Whereas, as illustrated in FIG. 8 annular compression spring 1030 urges annular ring 1020 into a first notch of each blade 900 when arrowhead 200 is in an in-flight or retracted configuration so as to retain each blade 900 in such position until acted upon by an opening force.

The arrowheads according to this invention having pivotal blades may be blade-opening arrowheads which are commonly known in the industry as mechanical broadheads, or may be non blade-opening arrowheads. It is apparent that the method of selectively retaining a pivotal blade of a blade-opening arrowhead in a closed or in-flight retracted position is of relatively minor significance to this invention. For example, as illustrated in FIG. 8 each blade 900 is biasedly flexed or camed against a corresponding fixed-blade 300 when arrowhead 200 is in a closed or in-flight configuration. This flexing could be used at least in part to selectively hold or retain pivotal blades 900 or other pivotal blades in a retracted or closed in-flight position or configuration.

As is particularly illustrated in FIGS. 1 & 8 washer 670 has a blade stop abutting surface 680 which serves to limit the rotation of blades 900 when expanded to the open position or penetrating configuration so as to define the cutting diameter of the arrowhead. It is apparent that the arrowheads as according to this invention may have varying types of blade stop structures such as washer 670 which serve to provide the functions of limiting the rotation of corresponding pivotal blades by abutting thereagainst, lessening the impact forces delivered to the hinge pin(s) and preventing undesirable damage to accompanying arrowshafts and/or other arrowhead structures. For example, the pivotal blades as according to this invention may abut against integrally attached or formed sections of corresponding arrowhead bodies, substantially flat blade stop washers or recessed blade stop washers like unto washer 670. Preferably the blade stop washers or equivalents as according to this invention are hardened sufficiently such as by case hardening, case hardening or other heat treating or hardening techniques so as to not substantially be damaged by the impacting blades during target penetration, such as when the blades collide with heavy bone of a large game animal.

FIG. 7 illustrates a fixed-blade 302 which is similar to fixed-blade 300 except blade 302 has a curved section 410 that fits snugly with the curvature of slots 700. As is illustrated in FIG. 5 an arrowhead tip 802 with a threaded female cavity 820 could be used in place of tip 800 by the addition of an arrowhead tip coupler 868.

As is best illustrated in FIG. 2 slots 700 are narrower than slots 750 and a slot 700 and a corresponding adjacent slot 750 are both substantially radially aligned with central longitudinal axis 1200 of arrowhead 200, and are in parallel alignment with each other, such that an elongate line

parallel to central longitudinal axis **1200** simultaneously intersects both a slot **700** and its corresponding paired or adjacent slot **750** as is according to the desired results of some of the preferred arrowhead embodiments of this invention. Each blade slot **750** of arrowhead **200** has a pair of partially bounding opposing sidewalls **753** that each extend to an exposed exterior corner **757** at the conjunction of sidewalls **753** with the exterior surface of arrowhead body **600** as is illustrated in FIGS. **1 & 2**. As according to this invention a blade slot generally includes its bounding sidewalls.

FIG. **9** illustrates an arrowhead **200b** which is similar to arrowhead **200** except that arrowhead **200b** has a plurality of slots **751** for pivotal blades **900** to be received therein which are non-radially aligned with respect to central longitudinal axis **1200** and a plurality of similarly non-radially aligned slots **702** for fixed-blades **300** to be received therein. It is apparent that there are various manners for the blade slots as according to this invention to be configured upon their corresponding arrowhead bodies such as to provide arrowheads that perform within the scope of this invention.

For example, FIGS. **10 & 11** illustrate an arrowhead **201** that is similar to arrowhead **200** except arrowhead **201** has a plurality of blade slots **706** for removably receiving a plurality of fixed-blades **304** that are each substantially the same thickness of a pivotal blade **900**. Each blade slot **706** is substantially a part of a corresponding slot **750** since slots **706 & 750** communicate with each other, wherein a slot **706** and a slot **750** could be fabricated from the same circular slitting saw by two-dimensional plunge slotting procedures.

FIGS. **12 & 13** illustrate an arrowhead **202** that is similar to arrowhead **200** except arrowhead **202** has a female cavity screw on arrowhead tip **802** as is clearly illustrated in FIG. **4**, a plurality of fixed-blade slots **704** and a plurality of hollow cylinders **676** (as is best seen in the cross-sectional view of the arrowhead body thereof in FIG. **13**) for receiving legs **404** of accompanying fixed-blades therein. It is apparent that the various structural variations that produce blade slots such as blade slots housing forward leading penetration enhancing fixed blades as according to this invention or their equivalents may be combined in various different manners one amongst another including in combinations that are not necessarily depicted in this specification so as to obtain the desired results of this invention.

FIGS. **14-16** illustrate an arrowhead **203** that is similar to arrowhead **200** except arrowhead

**203** has a plurality of fixed-blade slots **708** that are contained or situated within corresponding adjoining slots **750** such that each slot **708** is substantially non-equidistantly displaced from opposing elongate sidewalls of its corresponding slot **750**. As is illustrated in FIG. 16 each slot **708** and corresponding slot **750** are parallelly aligned with each other such that slots **750** are radially aligned with the central longitudinal axis of arrowhead **203** but slots **708** are non-radially aligned therewith.

Radial alignment in contrast to non-radial alignment generally refers to the geometric orientation or positioning of an element with respect to a radial line extending outward from a central longitudinal axis of a reference object such as an arrowhead body or an arrowhead. With reference to blade slots, a plane parallel to opposing sidewalls of a corresponding blade slot that is equidistantly displaced between such sidewalls such that the plane is substantially in coplanar alignment with the central longitudinal axis of an accompanying arrowhead generally constitutes a radially aligned blade slot, whereas such a plane that is not substantially in coplanar alignment with the central longitudinal axis of an accompanying arrowhead generally constitutes a non-radially aligned blade slot. It is apparent that such definition is allowed to fluctuate within the realm of attainable manufacturing tolerances so that the intent of the arrowhead design should generally dictate radial versus non-radial orientations thereof.

FIGS. 17-19 illustrate an arrowhead **204** that is similar to arrowhead **200** except arrowhead **204** has a plurality of fixed-blade slots **710** such that each fixed-blade slot **710** is situated at a distance spaced apart from its corresponding adjacent slot **750**. As is illustrated in FIG. 19 each slot **710** and corresponding adjacent slot **750** are parallelly aligned with each other such that slots **750** are radially aligned with the central longitudinal axis of arrowhead **204** but slots **710** are non-radially aligned therewith.

FIGS. 20 & 21 illustrate an arrowhead **205** and an arrowhead **206** which are similar to arrowhead **200** except that both arrowheads **205** and **206** have fixed-blade slots that are spaced apart from corresponding adjacent main cutting blade slots **750** such that their fixed-blade slots are radially aligned with corresponding arrowhead central longitudinal axes and their fixed-blade slots are not in parallel alignment with corresponding adjacent slots **750**.

FIGS. 22-24 illustrate an arrowhead **207** which is similar to arrowhead **204** except that arrowhead **207** has a plurality of fixed-blades **306** attached to an arrowhead body **608** having an

externally exposed annular recess **782** formed thereon for removably receiving an annular ring **1050** which aids in the securement of blades **306** to arrowhead body **608**. Externally exposed annular recess **782** comprises a lip **784** which aids in maintaining annular ring **1050** attached to arrowhead body **608** so as to perform its function. It is apparent that annular ring **1050** could be either compressed to a narrower diameter or expanded to a wider diameter when seated in recess **782** as compared to its non-attached or free diameter.

FIGS. **25-27** illustrate an arrowhead **208** which is similar to arrowhead **207** except that arrowhead **208** utilizes a plurality of partially threaded set screws **1004** that each screw into a through hole **786a** in an arrowhead body **610** which aids in the securement of blades **300** to arrowhead body **610**. As is illustrated in FIG. **27** it is apparent that a fully threaded set screw **1002** could be used in place of set screw **1004**.

FIGS. **28-30** illustrate an arrowhead **209** which has an arrowhead body **612**, a female arrowhead tip **802** and a plurality of fixed-blades **308** each having an aperture **450** sized so as to removable receive a set screw such as set screw **1004** therein. Arrowhead body **612** has a threaded through hole for receiving each set screw **1004** which attaches blades **308** to arrowhead **209** each within a blade slot **716**. As is illustrated in FIG. **31** from a fixed-blade **310** with a forward locking end **416** it is apparent that the forward locking ends of the fixed-blades as according to this invention may have any shape such that enables them to be secured to their corresponding arrowhead tips or arrowhead bodies or equivalents.

FIGS. **32-34** illustrate an arrowhead **210** which is similar to arrowhead **200** except that arrowhead **210** utilizes a plurality of partially threaded set screws **1010** for pivotally connecting a plurality of three pivotal blades **902** to an arrowhead body **614**, and a conventional rubber O-ring **1040** for selectively retaining blades **902** in an in-flight configuration until acted upon by an opening force. Blades **902** are of a length such that each cutting edge **950** thereof is displaced rearward of its corresponding adjacent fixed-blade **300** such that blades **902** and blades **300** do not biasly flex against each other when the arrowhead is in an in-flight configuration as is illustrated in FIG. **32**. Arrowhead body **614** has an arrowshaft contacting surface **1082** that is integral or substantially non-removably attached with arrowhead body **614** and a blade stop abutting surface **682** for each blade **902**. Blade stop abutting surfaces **682** are also integral with arrowhead body **614**.

It is apparent that the arrowhead tips of the arrowheads as according to this invention may be removable attachable from their corresponding arrowhead bodies such as having internal female threaded bores or externally protruding threaded male studs. It is apparent that the arrowhead tips of the arrowheads as according to this invention may be substantially non-removably attached to corresponding arrowhead bodies such as being frictionally press-fitted thereon, welded or glued on. It is also apparent that the arrowhead tips of the arrowheads as according to this invention may be substantially integrally formed with their corresponding arrowhead bodies, such as substantially being a machined or milled forward extending section of an accompanying arrowhead body that for example, is fabricated from a single piece of metal stock.

FIGS. 35-37 illustrate an arrowhead 211 which has an arrowhead tip 804 integrally formed with an arrowhead body 616. Arrowhead 211 has a plurality of three fixed-blade slots 720 formed thereon, a pair of fixed-blades 312 which are substantially non-removably attached thereto by welding or other similar result producing techniques, and a fixed-blade 318 attached thereto by a pair of set screws 1006 removably received through a pair of apertures 452 when threaded into a pair of through holes 786b formed in arrowhead 211. FIGS. 38 & 39 illustrate fixed-blades 314 & 316 which are at least in part similar to blades 312 & 318 and as is also their methods of attachment to corresponding arrowhead bodies, except that blades 314 & 316 have forward locking protrusions 418 projecting forwardly therefrom. It is apparent that a void such as a milled out hollow cylinder could be formed communicatingly with each slot 720 so as to matingly receive forward locking protrusions 418 when blades 314 & 316 or other similar blade designs having forward locking protrusions or equivalents as according to this invention are attached with accompanying arrowhead bodies or arrowhead tips, particularly with arrowheads having arrowhead tips substantially integrally formed with their corresponding arrowhead bodies or other arrowhead structure such as has arrowhead 211.

FIGS. 40-44 illustrate an arrowhead 212 and an arrowhead 213 both of which utilize a plurality of pivotal blades 320 to provide friction reducing forward leading cutting edges 400 as according to the penetration enhancement desired results of this invention. Each blade 320 is pivotally connected to corresponding arrowhead bodies by a hinge pin 1008 within corresponding slots (a plurality of slots 722 of arrowhead 212 and a plurality of slots 724 of arrowhead 213) as has

been illustrated herein with forgoing preferred embodiments.

FIGS. 45-47 illustrate an arrowhead 214 which is similar to arrowhead 212 except that arrowhead 214 utilizes a plurality of pivotal blades 322 to provide friction reducing forward leading cutting edges 400 for penetration enhancement. As is illustrated in FIG. 45 by aid of a line 1070 which is parallel to the central longitudinal axis of arrowhead 214, when arrowhead 214 is in an in-flight configuration furthest section 1072 of each cutting edge 400 from the central longitudinal axis of arrowhead 214 is closer to the central longitudinal axis of arrowhead 214 than furthest section 1074 of each pivotal blade 902. This provides for an aerodynamically favorable and penetration enhancing arrowhead as is according to this invention. FIG. 47 illustrates blades 902 rotated to their fully open position and abutting against integral blade stop surfaces 682.

FIGS. 48-54 illustrate an arrowhead 215 which is similar to arrowhead 210 except that arrowhead 215 utilizes a plurality of fixed-blades 324 that each have a bent portion or a flange 470, an arrowhead tip 810, and an arrowhead body 624 with a plurality of three fixed-blade slots 726 each having a thickness or a width of at least twice the thickness of a blade 324. Arrowhead tip 810 has an undercut locking cavity 844 and an undercut locking surface 845. Locking surface 845 engages or abuts against a square stepped forward locking end 420 of each blade 324 when the arrowhead is assembled so as to aid in the securement of blades 324 to arrowhead body 624. As is clearly illustrated in FIG. 49 bent portion 470 of each blade 324 is housed within a neighboring slot 726 that is spaced apart from the slot 726 the rest of the particular blade 324 is housed within. As is illustrated in FIGS. 51 & 54 each blade 324 has a pair of opposing exterior surfaces or side faces which are depicted as 480, 490 & 480, 490 for each blade 324 respectively, and which are distinct from a blade edge 401 extending peripherally thereabout. Peripheral blade edge 401 includes grind bevels 402-402 and cutting edge 400. Each exterior side face 480 is substantially flat or planar as is each exterior side face 490, however since flange 470 is bent, exterior side faces 490 are not in coplanar alignment with exterior sides faces 480 but are offset therefrom by substantially 120 degrees. Bent portions 470 by being housed in neighboring spaced apart slots 726 aid in the securement of blades 324 to arrowhead body 624 when the arrowhead is assembled.

FIGS. 55-61 illustrate arrowheads 216-218 which are similar to arrowhead 215 except that arrowheads 216-218 have fixed-blades with angular offsets between exterior side faces 480 & 490



that differ from the angular offset between exterior side faces **480 & 490** of blades **324**. Arrowhead **217** has a plurality of four blades **328** each with an angular offset between exterior side faces **480 & 490** of substantially 90 degrees, and arrowhead **218** has a plurality of five blades **330** each with an angular offset between exterior side faces **480 & 490** of substantially 72 degrees. Arrowhead **216** has a plurality of two blades **326** each with an angular offset between exterior side faces **480 & 490** such that a face **490** of each blade **326** abuts against each other when aiding in the securement of blades **326** to the arrowhead.

FIGS. **64-68** illustrate an arrowhead **219** which is similar to arrowhead **215** except that arrowhead **219** has a plurality of hollow cylinders **678** each communicating with a blade slot **728** that together house or secure a plurality of fixed-blades **332** to an arrowhead body **626**. Arrowhead body **626** has a male stud **788b** that threadably receives a female tip **812** thereon. Bent flange **470** of each blade **332** is received in a corresponding hollow cylinder **678** as is illustrated in FIG. **67**. As is illustrated in FIG. **68** a central elongate axis **1070** of each cylinder **678** is spaced apart from a central longitudinal axis **1060** of arrowhead body **626** so as to not be collinear therewith.

FIGS. **69 & 70** illustrate arrowheads **220 & 221** which are similar to arrowhead **219** except arrowheads **220 & 221** differ in number of blades **332** and corresponding hollow cylinders **678**.

FIGS. **71 & 72** illustrate an arrowhead **224** which is similar to arrowhead **219** except that arrowhead **224** has a plurality of narrower diameter hollow cylinders **684** and a plurality of corresponding different shaped blades **334** to snugly fit therewith.

FIGS. **73-75** illustrate arrowheads **222 & 223** which are similar to arrowhead **219** except arrowheads **222 & 223** utilize a male threaded stud arrowhead tip **814**.

FIGS. **76-82** illustrate an arrowhead **225** which is similar to arrowhead **215** except that arrowhead **225** has a centrally located hollow cylinder **687** that communicates with a plurality of blade slots **730** that together secure a plurality of fixed blades **336** to an arrowhead body **628**. Hollow cylinder **687** is bound at least in part by an internal wall surface **688** as is illustrated in FIG. **80**. As is illustrated in FIG. **79** shaft **830** of arrowhead tip **814** is disposed in cylinder **687** when the arrowhead is assembled so that bent portion **470** of each blade **336** is located between shaft **830** and internal wall **688** which aids in the attachment or securement of blades **336** to arrowhead body **628**.

FIGS. **83-85** illustrate arrowheads **226-228** which are similar to arrowhead **225** except

arrowheads **226-228** differ in the number of blades **336** contained therewith.

FIGS. **86 & 87** illustrate an arrowhead **229** having an upper arrowhead body piece **630b** and a lower body piece **630a** that threadably attach to each other in such a manner so as to secure a plurality of blades **338** into a plurality of corresponding blade slots **730** and to provide an arrowhead that achieves the desired results as according to this invention.

FIG. **88** illustrates an arrowhead **230** which is similar to arrowhead **229** except that arrowhead **230** removably receives male tip **814** whereas arrowhead **229** utilizes female tip **810** and arrowhead **230** utilizes a plurality of fixed-blades **340** each having a beveled locking end **405** that is seated in-line with a locking bevel **734** of an upper arrowhead body piece **632b** thereof when assembled into an arrowhead. FIG. **89** illustrates a fixed-blade **342** which is similar to fixed-blade **340** except that fixed-blade **342** has a bent flange **470** for additional aid in securement of blades **342** to an accompanying arrowhead as has been set forth herein.

FIG. **90** illustrates an arrowhead **231** having a removably attachable blade stop washer **673** and an arrowhead body **634** with a plurality of inclined slots **758** and a plurality of inclined slots **736** to receive a plurality of blades **902** and a plurality of blades **300** respectively. Blades **300** and **902** are inclined relative to central longitudinal axis **1200** of arrowhead **231** in such a manner that a cutting edge **400** and a cutting edge **950** of corresponding paired or adjacent blades **902** and **300** are in substantial coplanar alignment with each other and cause arrowhead **231** to spin when penetrating a target. As illustrated in FIG. **90** blades **902** abut against a slightly beveled abutting surface **683** of a substantially flat blade stop washer **673**. It is apparent that arrowheads having spin inducing capacities as according to this invention such as when penetrating a substance or when in-flight, such as arrowhead **231**, may have any type of blade stop abutting surface or blade stop washer or equivalent as has been set forth herein, or as is known to those skilled in the art.

FIGS. **91 & 92** illustrate an arrowhead **232** which is similar to arrowhead **231** except that arrowhead **232** has facet boundaries **870** substantially in-line with cutting edges **400** and **950**. Arrowhead **232** like arrowhead **231** when penetrating a target spins counter clockwise when viewed from above, or right handedly when viewed from the side. FIG. **92** in particular illustrates that a facet exterior surface **850b** on one side of each facet boundary **870** has substantially the same slope at distances equidistantly displaced from facet boundary **870** as does a facet exterior surface **850a**

on an opposing side of facet boundary 870.

FIGS. 93-105 illustrate arrowheads 233-238 which are similar to arrowhead 232 in that arrowheads 233-238 each have inclined blades to induce spinning upon target penetration but differ in varying manners from arrowhead 232 as will be set forth herebelow.

Arrowhead 233 as illustrated in FIG. 93 has a plurality of non-linear or curved facet boundaries 874 that curve in a clockwise direction when viewed from above. The arrowhead tip of arrowhead 233 has a facet exterior surface 854b on one side of each facet boundary 874 that has a substantially different slope than the slope of a facet exterior surface 854a on an opposing side of each facet boundary 874 as is illustrated in FIG. 94. Particularly, as illustrated in FIG. 94 facet exterior surface 854b has a more dished out or concave slope than does facet exterior surface 854a. It is apparent that facet exterior surfaces 854a & 854b or other similar facet exterior surfaces of this invention as illustrated in FIG. 94 could be reversed so as to be such as is illustrated in FIG. 95. It is apparent that facet exterior surfaces 854a & 854b or other similar facets of this invention that have differing slopes on opposing sides of corresponding facet boundaries could have convex facets, or at least a section thereof that is substantially convex.

When arrowhead 233 is penetrating a target such as a game animal facet exterior surfaces 854a & 854b create differing resistive forces due to their differing slopes or shapes which induces a net rotational force in a particular direction upon arrowhead 233 so as to cause it to turn or spin about its central longitudinal axis. Such rotational force can induce an increased spinning effect upon the arrowhead if aligned in the same direction as the spinning force produced from the inclined blades, or it can produce a braking effect if directed in opposition to the spin induced force of the inclined blades. Blades 902 & 300 induce clockwise spinning upon arrowhead 233 when viewed from above or left handed spinning when viewed from the side. It is apparent that the various spin or braking inducing designs of the various embodiments of this invention may be combined with each other and with the various different arrowheads as according to this invention, as well as with other such result producing arrowheads known to those skilled in the art, including in manners that have not been suggested herein, such as with embodiments taught in my U. S. Patent application Serial No. 08/ 858 096 filed May 17, 1997 which is incorporated herein by specific reference.

Arrowhead 234 as illustrated in FIG. 96 has a plurality of non-linear or curved facet

boundaries **876** that curve in a counter clockwise direction when viewed from above, and the facet exterior surfaces of a plurality of facets **858** thereof have substantially the same slope on opposing sides of each facet boundary **876**. It is also apparent that curved facet boundaries such as facet boundaries **874 & 876** can also induce or enhance spinning or braking in and of themselves by providing a drill-bit effect when penetrating target material.

Arrowhead **235** as illustrated in FIG. **98** has a plurality of linear or non-curved facet boundaries **890** such that a facet exterior surface **860b** on one side of each facet boundary **890** has a substantially different slope than the slope of a facet exterior surface **860a** on an opposing side of facet boundary **890** as is illustrated in FIG. **99**. The term linear as used herein refers to being straight, such as a straight line.

Arrowhead **236** as illustrated in FIG. **100** has a plurality of three facets **862**, and a plurality of non-radially aligned linear facet boundaries **892** that terminate in a forward leading end **1092** thereof. It is apparent that forward end **1092** may have a variety of different shapes including flat, concave, convex, pointed or such so as to be sharpened for cutting, chiseling or wedging. Blades **902** of arrowhead **236** are substantially non-radially aligned with the central longitudinal axis of arrowhead **236** which can enhance either the spinning or braking effects thereof depending on the directions the other spin inducing forces are directed thereon. Arrowhead tips as according to this invention having non-radially aligned facet boundaries, which may also comprise a cutting edge, will cause a spin or rotational force to be exerted upon corresponding arrowheads in such a similar manner as do non-radially aligned opened cutting blades.

Arrowhead **237** as illustrated in FIG. **101** has a plurality of three facets **864**, and a plurality of non-radially aligned linear facet boundaries **894** that connect to a forward leading end **1094** of the arrowhead by a plurality of radially aligned ridges **895**. It is apparent that ridges **895** may comprise, but not be limited to, facet boundaries as according to this invention. Blades **902** of arrowhead **237** are also substantially non-radially aligned with the central longitudinal axis of the arrowhead.

Arrowhead **238** as illustrated in FIG. **102** has a plurality of three facets **866**, and a plurality of non-radially aligned curved facet boundaries **896** that connect to a forward leading end **1096** thereof. Blades **902** of arrowhead **237** are also substantially non-radially aligned with the central longitudinal axis of the arrowhead. It is apparent that facets **862, 864 & 866** of arrowheads **236-238**

may have any sloped exterior facet shape, such as is illustrated in FIGS. 103-105 or other variations thereof.

FIGS. 106-108 illustrate an arrowhead 239 which has a plurality of fixed-blades 344 removably attached in a plurality of blade slots 738. It is apparent that the penetration enhancing forward leading cutting edges or edge such as cutting edges 400 of blades 344 as according to this invention situated at least in part forward of a main cutting blade when a corresponding arrowhead is in a penetrating configuration may extend for any axial or elongate length upon corresponding arrowhead bodies.

FIGS. 109-115 illustrate other arrowheads as according to this invention which have fixed-blades of similar lengths as blades 344 of arrowhead 239.

FIG. 109 illustrates that it is apparent that a blade 346 with an aperture can be attached to an arrowhead similar to arrowhead 209 as illustrated in FIG. 28.

FIG. 110 illustrates that it is apparent that a blade of similar length as blade 344 can be attached with an arrowhead similar to arrowhead 219 as illustrated in FIGS. 64-68.

FIGS. 111-113 illustrate that a blade 348 having a bent portion 470 can be attached with an arrowhead 240 which is similar to arrowhead 225 as illustrated in FIGS. 76-82. Arrowhead 240 has an arrowhead tip 816 that has a substantially longer shaft 832 than shaft 830 of arrowhead tip 814 which is received in an accompanying substantially elongate longer cylinder or bore having at least an internal section thereof threaded.

It is apparent that the internal cylinders or bores of arrowheads as according to this invention, including ones that are substantially centrally oriented about an accompanying arrowhead central longitudinal arrowhead axis, may extend for any elongate length within their corresponding arrowhead bodies, including to a distance substantially near an accompanying arrowshaft contacting surface.

FIGS. 114 & 115 illustrate that a blade 350 having a bent portion 470 can be attached with an arrowhead 241 which is similar to arrowhead 215 as illustrated in FIGS. 48-52.

FIGS. 116 & 117 illustrate an arrowhead 242 which has an arrowhead body 640 and a plurality of fixed-blades 352 removably attached in a plurality of blade slots 740. Each pivotal blade 902 is pivotally connected within a blade slot 760 which has a forward wider section 760a and

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a rearward narrower section **760b**. Each rearward slot section **760b** is preferably substantially not less in width than the thickness of a blade **902** so as to hold each blade **902** relatively snugly therein and to therefore prevent any undesired blade wobble upon target penetration. Each forward slot section **760a** is preferably substantially of a width wide enough so as to allow each blade **902** to be folded into a retracted or closed in-flight position adjacent arrowhead body **640** such that arrowhead **242** maintains an aerodynamically favorable in-flight profile.

FIGS. **118 & 119** illustrate a blade **354** and a blade **356** that each have a leg **404** disposed thereon at a location substantially forward of their rear end sections. Cutting edge **400** of blade **356** has a forward section **400a** and a rearward section **400b**, which do not have at least a linear section thereof collinear with one another. Arrowhead blades **354 & 356** could be attached to the arrowhead body of arrowhead **239** as illustrated in FIG. **106** which would produce arrowheads having friction reducing or penetration enhancing forward leading cutting edges similar to that which arrowhead **242** sports.

FIGS. **120-122** illustrate that it is apparent that substantially elongate blades such as a blade **358** and a blade **360** with set screw receiving apertures can be attached to an arrowhead in a similar manner as blades **308** are attached to arrowhead **209** as illustrated in FIG. **28**.

FIGS. **123-128** illustrate other arrowheads as according to this invention which have fixed-blades of a similar length as blades **352** of arrowhead **242**.

FIGS. **123-125** illustrate that a blade **362** or a blade **364** each with a bent portion **470** can be attached to an arrowhead **243** or other similar arrowheads which are similar to arrowhead **240** as illustrated in FIGS. **111-113**. FIGS. **126-128** illustrate that a blade **366** or a blade **368** each with a bent portion **470** can be attached with an arrowhead **244** or other similar arrowheads which are similar to arrowhead **241** as illustrated in FIGS. **114 & 115**.

It is apparent that the friction reducing forward leading cutting edges or edge for enhanced penetration such as a cutting edge **400** as according to this invention situated at least in part forward of a main cutting blade when a corresponding arrowhead is in a penetrating configuration may project outward from the exterior surface of a corresponding arrowhead body a very small distance while serving to provide the penetration enhancement desired results of this invention.

FIG. **129** illustrates an arrowhead **245** which is similar to arrowhead **242** as illustrated in FIG.

116 except that arrowhead **245** utilizes a plurality of fixed-blades **357** which are at least in part similar to blade **356** as illustrated in FIG. **119**.

FIG. **130** illustrates an arrowhead **246** which is similar to arrowhead **245** except that arrowhead **246** utilizes a plurality of fixed-blades **370** which extend in axial or elongate length upon the arrowhead body thereof substantially less than that which blades **357** do. Arrowhead **246** has a plurality of slots **762** for housing the pivotal blades thereof, such that each slot **762** has a wider forward section **762a** and a narrower rearward section **762b**.

FIGS. **131** & **132** illustrate an arrowhead **247** which has an arrowhead body **646** and a plurality of fixed-blades **372** each with a hinge pin receiving aperture **460** and a forward locking end **416**. Arrowhead body **646** has a plurality of blade slots **746** and a plurality of blade slots **764** for receiving blades **372** and **902** respectively therein. Each cutting edge **400** of blades **372** is not in coplanar alignment with the cutting edge **950** of its corresponding paired adjacent pivotal blade **902**. Each blade **902** has a hinge pin receiving aperture **906** for receiving a hinge pin such as partially threaded set screw **1010**. Set screws **1010** pass through apertures **906** and **460** when threaded into arrowhead body **646** so as to attach or secure the rear end of each blade **372** to arrowhead body **646** as well as to pivotally connect blades **902** to arrowhead body **646**.

It is apparent that the penetration enhancement forward leading cutting edges or edge such as a cutting edge **400** as according to this invention situated at least in part forward of a main cutting blade when a corresponding arrowhead is in a penetrating configuration may extend substantially rearward to approximately near the forward most terminus or section of the cutting edge of a main arrowhead cutting blade, such as near to a cutting edge **950** of a pivotal blade.

FIGS. **133-137** illustrate a fixed-blade **374** and a fixed-blade **376**. Fixed-blade **374** has a set screw receiving aperture **458** in addition to aperture **460** for aiding in the attachment of blade **374** to a corresponding arrowhead body. Fixed-blade **376** has an aperture **462** in addition to aperture **460** for aiding in the attachment of blade **376** to a corresponding arrowhead body. FIG. **137** illustrates that an annular ring **1014** could be extended through aperture **462** of blade **376** when blade **376** is attached to an arrowhead.

It is apparent that cutting blades such as fixed-blade **372** or other substantially elongate similar function providing blades may be housed in blades slots that are spaced apart a distance away

from the blade slots of a corresponding arrowhead which house the main arrowhead cutting blades.

FIGS. 138-141 illustrate an arrowhead 248 and an arrowhead 249 which are similar to arrowheads heretofore disclosed, except arrowheads 248 & 249 utilize blades having hinge pin apertures 460 such as a blade 378 or a blade 380.

FIG. 142 illustrates an arrowhead 250 which is similar to arrowhead 247 except that arrowhead 250 has a plurality of slots 766 for housing main cutting pivotal blades 902 and forward leading penetration enhancing cutting blades 372 therein. Therefore, arrowhead 250 only utilizes one blade slot 766 for housing each corresponding pair of blades 372 & 902.

FIG. 143 illustrates an arrowhead 251 which is similar to arrowhead 250 except that arrowhead 251 has an arrowhead body 650 that has a constant sloped taper from the rear end of its arrowhead tip rearward to the widest section 1076 of arrowhead body 650.

FIG. 144 illustrates an arrowhead 252 which is similar to arrowhead 247 of FIG. 131 except arrowhead 252 has a plurality of fixed-blades 384 that each are similar at least in part to blades 356 and 357 as previously disclosed.

FIG. 145 illustrates an arrowhead 253 which is similar to arrowhead 246 of FIG. 130 except arrowhead 253 has a plurality of blade slots 752 that each have a substantially uniform width for their entire axial or elongate length.

FIGS. 146 & 147 illustrate an arrowhead 254 which has a plurality of fixed-blades 386 housed within a plurality of blade slots 740 and an annular rubber O-ring 1042 for blade retention seated within an externally exposed annular recess 690. As is clearly illustrated in FIG. 146 when arrowhead 254 is in an in-flight configuration the widest section 1072 of each cutting edge 400 is situated closer to the central longitudinal axis of the arrowhead than the widest section 1074 of each pivotal blade 902.

FIG. 148 illustrates an arrowhead 255 which is similar to arrowhead 254 except that arrowhead 255 has a plurality of vented fixed-blades 388 each with a vent or cut-out section 430 and a plurality of pivotal blades 908 each having a notch 960 formed therein for receiving a conventional rubber O-ring which selectively retains or holds blades 908 in an in-flight configuration.

FIGS. 149 & 150 illustrate an arrowhead 256 with an arrowhead body 652 that has a plurality of integral cutting protrusions 550 each with a cutting edge 500 formed thereon. Each



integral cutting protrusion 550 is integrally fabricated or formed upon its arrowhead body 652 at least in part during a manufacturing process or processes such as grinding and/or impact swaging and/or milling etc. Each integral cutting protrusion 550 as is clearly illustrated in FIG. 150 has a pair of primary bevels 510 such as could substantially be, but not limited to, grind bevels disposed on either side thereof and a pair of side faces 520. As is illustrated in FIG. 149 each cutting edge 500 is substantially in coplanar alignment with a cutting edge 950 of a corresponding pivotal blade.

As referenced in a plane perpendicular to the central longitudinal axis of arrowhead 256 the location upon each integral cutting protrusion 550 where the exterior surface of arrowhead body 652 (and therefore the external surface of each integral cutting protrusion 550) changes slope either marks the boundary or junction of a primary bevel 510 with a side face 520, or the boundary of a side face 520 with the junction of the arrowhead body 652 that is not comprised of an integral cutting protrusion 550, or the cutting edge boundary 500 with opposing primary bevels 510 on either side thereof. As is clearly illustrated in FIG. 150 at least a section of the exterior surface of arrowhead body 652 that is not comprised of an integral cutting protrusion 550 extends between each integral cutting protrusion 550.

It is apparent that integral cutting protrusions as according to this invention could consist essentially of only one side face 520 and one primary bevel 510 in addition to a cutting edge 500, or that integral cutting protrusions as according to this invention could consist essentially of only two side faces 520 in addition to a cutting edge 500, or that integral cutting protrusions as according to this invention could be comprised of other combinations of the various components of the integral cutting protrusions as according to this invention as disclosed within this specification.

Cutting edges 500 of the integral cutting protrusions as according to this invention serve to provide substantially the same function as cutting edges 400 as has been taught herein, in that cutting edges 500 act as forward leading cutting edges which are situated at least in part forward of a main cutting blade when a corresponding arrowhead is in a penetrating configuration so as to provide aerodynamically favorable arrowheads that enhance penetration by reducing the frictional drag that otherwise would of been generated between an arrowhead and target material by cutting such target material in front of the main cutting blade(s) during penetration.

FIGS. 151-162 illustrate arrowheads 257-268 which disclose a variety of different arrowhead

bodies and differing integral cutting protrusion examples as according to this invention. Such arrowheads are only considered examples of integral cutting protrusion as according to this invention and are not intended to be an all inclusive exhaustive collection thereof. Although the cross-sectional views of arrowheads **257-268** are taken substantially in a plane perpendicular to the central longitudinal axes of corresponding arrowheads so as to not intersect corresponding blades slots of the arrowheads, it is apparent that such cross-sectional views could also intersect corresponding blade slots and thus illustrate yet other arrowheads as according to this invention.

It is apparent that the arrowhead bodies of the arrowheads as according to this invention may be comprised of sharpenable materials such as composites or other organic polymers, metals particularly steels such as carbon steels, high carbon steels, various stainless steels and/or chrome-moly steels, carbides or other metals such as the various aluminum, titanium and vanadium alloys. It is apparent that the arrowhead bodies as according to this invention may be hardened in heat treating processes and that the integral cutting protrusions as according to this invention may be heat treated and/or hardened so as to retain an optimally desirable cutting edge as is according to the desired results of this invention. It is yet further apparent that arrowhead bodies as according to this invention being fabricated from composite or other moldable polymeric type materials including those combinable with matrix reinforcing elements may have cutting blades molded with such arrowhead bodies or arrowheads as is according to this invention.

It is within the desired results of this invention to provide a cutting edge located forward of a main cutting blade when an accompanying arrowhead is in a penetrating configuration that is as sharp as a virgin ground, honed and stropped razor edge. However, it is apparent that obtaining such a fine or razor sharp cutting edge as according to this invention is not of necessity a requirement for the arrowheads as according to this invention. For example, an edge or equivalent that cuts regardless of its sharpness located forward of a main cutting blade, when an accompanying arrowhead is in a penetrating configuration, that enhances penetration and/or reduces frictional drag in such a manner so that the arrowhead performs better in such desired objective traits than it would of otherwise performed without the forwardly located cutting edge(s) as according to this invention will meet the desired results of this invention.

Referring again to FIGS. **151-162** and arrowheads **257-268**, FIG. **152** illustrates arrowhead

258 having a plurality of integral cutting protrusions 552 that each have a pair of primary bevels 510 and a cutting edge 500.

FIG. 153 illustrates an arrowhead 259 having a plurality of integral cutting protrusions 554 that each have a pair of primary bevels 510, a pair of side faces 520, a pair of secondary bevels 530 which could be identified as but not limited to hone bevels, and a cutting edge 500. Side faces 520 of each integral cutting protrusion 554 are substantially parallel to each other.

For the integral cutting protrusions as according to this invention having a pair of hone bevels 530 or secondary bevels or only one hone bevel 530 in addition to a primary bevel 510 and/or a side face 520 or equivalents it is apparent that a change in slope of the exterior surface of the corresponding arrowhead body will also mark the junction or boundary of a hone bevel 530 with an adjoining different sloped exterior surface component of the integral cutting protrusion or other arrowhead structure.

FIG. 155 illustrates an arrowhead 260 having a plurality of integral cutting protrusions 556 that each have a pair of primary bevels 510, a pair of side faces 520 and a cutting edge 500. Side faces 520 of each integral cutting protrusion 556 are substantially not parallel to each other.

Arrowhead 261 as illustrated in FIG. 156 has a plurality of integral cutting protrusions 558 which are similar to integral cutting protrusions 552. Arrowhead 265 as illustrated in FIG. 158 has a plurality of integral cutting protrusions 564 which are substantially the exposed corners of the conjunction of adjoining convex portions of the arrowhead body. Arrowhead 266 as illustrated in FIG. 161 has a plurality of integral cutting protrusions 560. And arrowhead 267 as illustrated in FIG. 159 has a plurality of integral cutting protrusions 562. It is apparent that an arrowhead tip as according to this invention could have a cross-section depicting a plurality of three convex facets such as is illustrated in FIG. 158.

FIGS. 163 & 164 illustrate an arrowhead 269 having a plurality of integral cutting protrusions 566 that each have a pair of primary bevels 510, a pair of side faces 520, and a cutting edge 500 thereon. As is illustrated by line 1070 which is parallel to the central longitudinal axis of arrowhead 269, the widest section 1072 of each integral cutting protrusion cutting edge 500 is further from the central longitudinal axis of the arrowhead than is the widest section 1076 of the arrowhead body that is located rearward of cutting protrusions 566.

FIGS. 165-180 illustrate cross-sectional views of arrowheads 270-285 and disclose a variety of different arrowhead bodies and different integral cutting protrusion examples as according to this invention. Arrowheads 270-285 all have non-radially aligned main cutting blade slots 779 as is clearly identified in FIG. 165. Although slots 779 are shown in dotted lines which illustrates that the cross-sections are taken perpendicularly substantially so as to not intersect blade slots 779 of arrowheads 270-285 it is apparent that the cross-sectional views as illustrated in FIGS. 165-180 could be illustrative of arrowhead perpendicular sections having slots such as slots 779 disposed explicitly in such cross-sections or other slot configurations as taught herein or as known in the art, and thus FIGS. 165-180 could also illustrate other arrowheads as according to this invention.

FIG. 169 illustrates an arrowhead 274 which has a plurality of integral cutting protrusions 568 that each have a pair of primary bevels 510, a pair of side faces 520 and a cutting edge 500. Arrowhead 274 has a plurality of non-cutting surface sections 666 and a plurality of three flats 664 each containing a plurality of integral cutting protrusions 568 thereon. A straight line 1078 positioned so as to lay against but not intersect the exterior surfaces of two non-cutting surfaces 666 of arrowhead 274 does not substantially have any portion of an integral cutting protrusion 568 extending or projecting outwardly therebeyond on a side of line 1078 opposite the side thereof that the central longitudinal axis of arrowhead 274 is located on.

FIG. 172 illustrates an arrowhead 277 which is similar to arrowhead 274 except that arrowhead 277 has a plurality of integral cutting protrusions 570 that each have only a pair of primary bevels 510 and a cutting edge 500. At least a section of the exterior surface of the arrowhead body of arrowhead 277 that is not comprised of an integral cutting protrusion 570 extends between each integral cutting protrusion 570.

It is apparent that arrowheads as according to this invention which are similar to arrowhead 274 or arrowhead 277 could exist wherein in place of flats 664 an arrowhead could have a convexity or a concavity or another shaped exterior surface equivalent such that a non-linear or non-straight line that performs the function of line 1078, which has the exact slope or slopes or shape as the non-flat other shaped exterior surface could be used to describe or teach such other arrowheads as line 1078 does for arrowheads disclosed herein.

FIGS. 181 & 182 illustrate an arrowhead 286 having a plurality of integral cutting

protrusions **572** that are inclined at an angle relative to the central longitudinal axis of arrowhead **286** so as to induce spinning on the arrowhead when penetrating a target.

FIGS. **183 & 184** illustrate an arrowhead **287** having a plurality of integral cutting protrusions **574**, a forward leading end **1098** and an integral arrowhead tip **818** having a plurality of facet boundaries **871** each with a cutting edge formed thereon. It is apparent that arrowhead tip **818** may have convex facets or flat facets or concave facets.

FIGS. **185 & 186** illustrate an arrowhead **288** having a plurality of integral cutting protrusions **576** that extend elongately rearward near to the forward most section or terminus of cutting edges **950** when arrowhead **288** is in a penetrating configuration. Each integral cutting protrusion **576** has a forward cutting edge section **500a** and a rearward cutting edge section **500b**. As is illustrated in FIG. **186** integral cutting protrusions **576** are non-radially aligned with the central longitudinal axis of the arrowhead.

FIGS. **187-193** illustrate cross-sectional views of arrowheads **289-295** and disclose a variety of different arrowhead bodies and different integral cutting protrusion examples as according to this invention. Arrowheads **289-295** each have a plurality of integral cutting protrusions that are radially aligned with the central longitudinal axes of their corresponding arrowhead bodies. Arrowhead **290** as illustrated in FIG. **188** has non-radially aligned main cutting blade slots **776a** which cause corresponding main cutting blades when in a penetrating configuration to produce a right handed spinning force on arrowhead **290**. Arrowhead **295** as illustrated in FIG. **193** has non-radially aligned main cutting blade slots **776b** which cause corresponding main cutting blades when in a penetrating configuration to produce a left handed spinning force on arrowhead **295**.

FIGS. **194 & 195** illustrate an arrowhead **296** that has an arrowhead body **662** and a plurality of integral cutting protrusions **582** that extend elongately rearward near to the forward most section or terminus of cutting edges **950**. Arrowhead body **662** has a constant sloped taper from the rear end of its arrowhead tip rearward to the widest section **1076** thereof. This is in contrast to arrowhead **288** as illustrated in FIG. **185** which does not have such constant slope tapered integral cutting protrusions **576**.

The arrowheads as according to this invention overcome deficiencies inherent in prior art arrowheads by providing arrowheads that enhance penetration and reduce the frictional drag that

otherwise would of been generated between an arrowhead and target material by cutting such target material in front of the main cutting blades during target penetration.

Although the main cutting blades of the arrowheads of this invention have been depicted as pivotal blades only throughout this specification, it is apparent that fixed blades could be used as main cutting blades as according to this invention.

Although the preferred embodiments of this invention have been depicted as having a plurality of three pivotal blades or main cutting blades each, with only one blade disposed in each corresponding blade slot, it is apparent that the arrowheads according to this invention may have any number of main cutting blades and any number of forward leading penetration enhancing cutting blades or cutting edges as according to this invention, with more than one being preferred. It is also apparent that more than one blade may be housed or contained in a single blade slot - particularly where a straight hinge pin has a plurality of at least two blades attached thereon.

It is apparent that the different and various elements of this invention may be made of light weight and strong materials, such as composites, organic polymers, resilient materials, aluminum alloys, titanium alloys, stainless steels and other metals and materials. It is also apparent that the arrowhead bodies of the arrowheads of this invention may be fastened to the forward end of an arrow shaft by any method, such as threading into an insert, or glueing thereon.

It is apparent that the different parts and elements and their equivalents of the arrowheads of this invention, as discussed above and according to other preferred embodiments of this invention, can be changed, or interchanged, or eliminated, or duplicated, or made of different materials, and connected to or associated with adjacent elements in different manners, other than suggested herein, without deterring from the desired results of the arrowheads of this invention. For example, arrowheads having at least in part features as disclosed in this specification may be combined with features of the embodiments and spirit of the arrowheads and cutting tips incorporated herein by specific reference.

It is to be understood that the present invention is not limited to the sole embodiments described above, as will be apparent to those skilled in the art, but encompasses the essence of all embodiments, and their legal equivalents, within the scope of the following claims.

**CLAIMS:** I claim:

1. An arrowhead comprising:
  - (a) a forward leading end;
  - (b) an arrowhead body having a central longitudinal axis;
  - (c) a cutting blade having a first cutting edge; and
  - (d) a second cutting edge configured upon said arrowhead such that at least a section thereof extends forward of said first cutting edge when said arrowhead is in a penetrating configuration, wherein when said arrowhead is in an in-flight configuration the perpendicular distance from said longitudinal axis to the furthest section of said cutting blade from said longitudinal axis is longer than the perpendicular distance the furthest section of said second cutting edge is displaced from said longitudinal axis.
2. An arrowhead as recited in claim 1 wherein when said arrowhead is in said penetrating configuration the forward terminus of said second cutting edge is located rearward of said forward leading end of said arrowhead.
3. An arrowhead as recited in claim 2 wherein the rearward terminus of said second cutting edge is located forward of a forward terminus of said first cutting edge.
4. An arrowhead as recited in claim 2 wherein the rearward terminus of said second cutting edge is located closer to said forward leading end of said arrowhead than to a forward end of an arrowshaft when said arrowhead is attached to said arrowshaft.
5. An arrowhead as recited in claim 2 wherein said second cutting edge has a linear length that is less than the linear length of said first cutting edge.
6. An arrowhead as recited in claim 2 wherein at least a section of said cutting blade projects outward from said arrowhead body when said arrowhead is in said in-flight configuration.

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7. An arrowhead as recited in claim 2 further comprising an arrowhead tip located at said forward leading end of said arrowhead, said arrowhead tip comprising a facet and a facet boundary such that said second cutting edge is located rearward of said facet boundary when said arrowhead is in said penetrating configuration.

8. An arrowhead as recited in claim 7 wherein said facet boundary is substantially in coplanar alignment with at least a linear section of said second cutting edge.

9. An arrowhead as recited in claim 2 wherein when said arrowhead is in said penetrating configuration a line parallel to said central longitudinal axis that is displaced a distance outward from an exterior surface of said arrowhead body intersects said second cutting edge while intersecting at least a section of said cutting blade.

10. An arrowhead as recited in claim 9 wherein said parallel line intersects said first cutting edge when intersecting said second cutting edge.

11. An arrowhead as recited in claim 9 wherein said cutting blade is pivotally hinged to said arrowhead body.

12. An arrowhead as recited in claim 11 wherein said arrowhead is a blade-opening arrowhead and said cutting blade rotates in a rearward direction when rotating from said in-flight configuration to said penetrating configuration.

13. An arrowhead as recited in claim 12 wherein when said arrowhead is in said penetrating configuration a first plane parallel to a side face of said cutting blade that intersects at least a linear section of said first cutting edge is not in perpendicular alignment with a second plane that is parallel to said central longitudinal axis and intersecting at least a linear section of said second cutting edge.



14. An arrowhead comprising:

- (a) a forward leading end;
- (b) an arrowhead body having a central longitudinal axis;
- (c) a pivotal blade connected to said arrowhead body so as to be enabled to rotate relative to said arrowhead body, said pivotal blade having a cutting edge which extends to a forward terminus when said arrowhead is in a penetrating configuration; and
- (d) a fixed blade having a cutting edge, said cutting edge comprising:
  - (i) a forward terminus; and
  - (ii) a rearward terminus, wherein when said arrowhead is in said penetrating configuration said forward terminus of said fixed-blade cutting edge is located rearward of said forward leading end of said arrowhead and said rearward terminus of said fixed-blade cutting edge is located forward of said forward terminus of said pivotal blade cutting edge.

15. An arrowhead as recited in claim 14 wherein said arrowhead body comprises an internal hollow cylinder that extends elongately for less than a majority of the length of the section of said arrowhead body that projects forwardly from an accompanying arrowshaft when said arrowhead is attached thereto.

16. An arrowhead as recited in claim 14 wherein said pivotal blade and said fixed-blade are each housed within a blade slot.

17. An arrowhead as recited in claim 16 wherein the blade slot that houses said fixed-blade and the blade slot that houses said pivotal blade communicate with each other.

18. An arrowhead as recited in claim 17 wherein the blade slot that houses said fixed-blade and the blade slot that houses said pivotal are substantially the same blade slot.

19. An arrowhead as recited in claim 16 wherein the blade slot that houses said fixed-blade and the blade slot that houses said pivotal blade are substantially different blade slots.

20. An arrowhead as recited in claim 19 wherein a line parallel to said central longitudinal axis intersects both said slots.

21. An arrowhead as recited in claim 16 wherein each said slot comprises a bounding sidewall, said sidewall of each said slot being substantially non parallel to each other.

22. An arrowhead as recited in claim 21 wherein at least one sidewall of the slot housing said fixed-blade is not perpendicular to at least one sidewall of the slot housing said pivotal blade.

23. An arrowhead as recited in claim 14 wherein said cutting edge of said pivotal blade is substantially in coplanar alignment with said cutting edge of said fixed-blade when said arrowhead is in said penetrating configuration.

24. An arrowhead comprising:

(a) an arrowhead body having:

(i) a central longitudinal axis;

(ii) an exterior surface; and

(iii) a first blade slot and a second blade slot configured thereupon such that at least a section of said second blade slot is located substantially forward of said first blade slot;

(b) a first blade attached to said arrowhead body at least in part within said first blade slot; and

(c) a second blade attached to said arrowhead body at least in part within said second blade slot, wherein a line parallel to said central longitudinal axis intersects both said blade slots.

25. An arrowhead as recited in claim 24 wherein each said slot is externally exposed to only one opposing elongate side of said arrowhead body.

26. An arrowhead as recited in claim 24 wherein each said blade slot comprises a pair of opposing bounding sidewalls that each extend to an exposed exterior corner at their conjunction with said arrowhead body exterior surface so that when said parallel line is displaced a perpendicular distance away from said central longitudinal axis equal to a perpendicular distance that at least one of said second slot exterior corners is displaced from said central longitudinal axis, such that said parallel line is not located outside of said second slot sidewalls, said parallel line intersects at least a section of said first slot.

27. An arrowhead as recited in claim 26 wherein said first slot is substantially parallelly aligned with said central longitudinal axis.

28. An arrowhead as recited in claim 24 wherein said second blade is located rearward of the forward leading end of said arrowhead body.

29. An arrowhead as recited in claim 24 wherein a forward terminus of said second slot does not communicate with said longitudinal axis.

30. An arrowhead as recited in claim 24 wherein when said arrowhead is in an in-flight configuration the perpendicular distance between said longitudinal axis and the furthest section of said first blade from said longitudinal axis is longer than the perpendicular distance between said longitudinal axis and the furthest section of said second blade from said longitudinal axis.

31. An arrowhead as recited in claim 24 wherein each said blade comprises a cutting edge.

32. An arrowhead as recited in claim 31 wherein at least a linear section of each said cutting edge is substantially in coplanar alignment with each other when the arrowhead is in a penetrating configuration.

33. An arrowhead as recited in claim 32 wherein a rearward terminus cutting edge of said second blade is situated substantially forward of said first blade when the arrowhead is in an in-flight configuration.

34. An arrowhead as recited in claim 31 wherein when said arrowhead is in an in-flight configuration a plane perpendicular to said longitudinal axis of said arrowhead body intersects both said first blade and said second blade.

35. An arrowhead as recited in claim 31 wherein said arrowhead is a blade-opening arrowhead such that when in an in-flight configuration a non-sharpened leading section of said first blade outwardly projects from said arrowhead body.

36. An arrowhead comprising:
- (a) an arrowhead body having a central longitudinal axis;
  - (b) a pivotal blade connected to said arrowhead body so as to be enabled to rotate relative to said arrowhead body; and
  - (c) a fixed-blade attached to said arrowhead body comprising:
    - (i) an edge extending peripherally thereabout; and
    - (ii) an exterior side face, wherein a plane coplanar with at least a section of said exterior side face is not parallel to at least another section of said exterior side face.
37. An arrowhead as recited in claim 36 wherein said fixed-blade has a bent portion such that blade material of said fixed-blade is capable of being simultaneously housed within a pair of spaced apart blade slots that communicate with each other.
38. An arrowhead as recited in claim 37 wherein said blade slots communicate with each other at least substantially near said central longitudinal axis.
39. An arrowhead as recited in claim 37 wherein said spaced apart blade slots are off set from each other by substantially 120 degrees.
40. An arrowhead as recited in claim 37 further comprising an arrowhead tip attachable to said arrowhead body so that when attached thereto a plane perpendicular to said central longitudinal axis intersects at least a section of both said fixed-blade and said arrowhead tip.



46. An arrowhead comprising:
  - (a) a forward leading end;
  - (b) an arrowhead body comprising:
    - (i) a central longitudinal axis;
    - (ii) a blade slot;
    - (iii) an exterior surface; and
    - (iv) a cutting edge integrally formed on said exterior surface, said cutting edge having a forward terminus that is displaced rearward of said forward leading end of said arrowhead; and
  - (c) a cutting blade having a cutting edge, said cutting blade being attached to said arrowhead body within said blade slot.
47. An arrowhead as recited in claim 46 wherein at least one hone bevel is configured adjacent said integrally formed cutting edge for at least a section of the length of said integrally formed cutting edge.
48. An arrowhead as recited in claim 46 having an integral cutting protrusion with said integral cutting edge formed thereon.
49. An arrowhead as recited in claim 48 wherein the exterior surface of said integral cutting protrusion on at least one side of said integral cutting edge as determined in a plane perpendicular to said central longitudinal axis has at least a section thereof with a differing mathematical slope than at least another section of said exterior surface of said integral cutting protrusion on said side of said integral cutting edge.
50. An arrowhead as recited in claim 46 further comprising a plurality of at least two integral cutting protrusions each having at least one said integrally formed cutting edge thereon, such that at least a section of said exterior surface of said arrowhead body that is not comprised of an integral cutting protrusion extends between at least a first integral cutting protrusion and a second integral cutting protrusion.

51. An arrowhead as recited in claim 46 wherein a line parallel to said central longitudinal axis intersects said blade slot and said integral cutting edge.

52. An arrowhead as recited in claim 51 wherein at least a linear section of said blade cutting edge and at least a linear section of said integral cutting edge are in coplanar alignment with each other.

53. An arrowhead as recited in claim 46 wherein a plane perpendicular to said central longitudinal axis intersects said blade slot and said integral cutting edge.

54. An arrowhead as recited in claim 46 wherein at least a section of said integral cutting protrusion extends forward of said blade slot.

55. An arrowhead as recited in claim 46 further comprising an integral arrowhead tip.

56. An arrowhead as recited in claim 55 wherein said arrowhead tip has an integrally formed cutting edge.

57. An arrowhead as recited in claim 56 wherein at least a linear section of said integrally formed cutting edge of said arrowhead tip is substantially in coplanar alignment with at least a linear section of said integrally formed cutting edge of said arrowhead body.

58. An arrowhead as recited in claim 46 wherein said blade slot is substantially non-radially aligned with said central longitudinal axis of said arrowhead body.

59. An arrowhead as recited in claim 58 wherein said cutting blade is a pivotal blade hingedly connected within said blade slot.

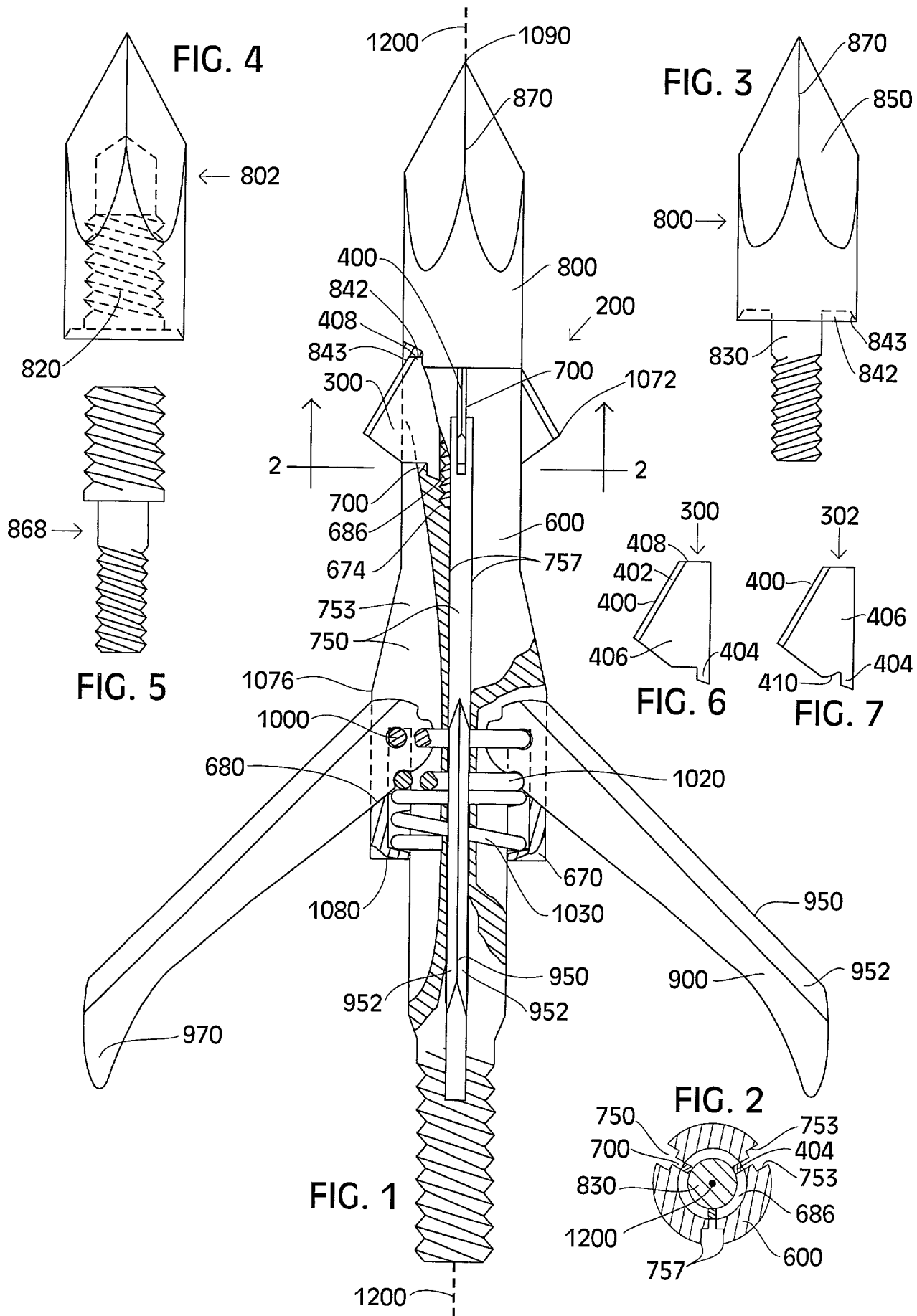


## **PENETRATION ENHANCING AERODYNAMICALLY FAVORABLE ARROWHEAD.**

### **ABSTRACT**

Aerodynamically favorable arrowheads such as pivotal blade arrowheads and/or blade-opening arrowheads that have a sharp cutting edge located upon their arrowhead bodies at a location forward of a corresponding main cutting blade cutting edge when in a penetrating configuration such that the arrowheads maintain favorable aerodynamic flight characteristics and cut target material in front of the main cutting blades when penetrating a target so as to eliminate the frictional drag that the otherwise dull arrowhead bodies would generate with the target before the main cutting blades began cutting target material thereinfront.

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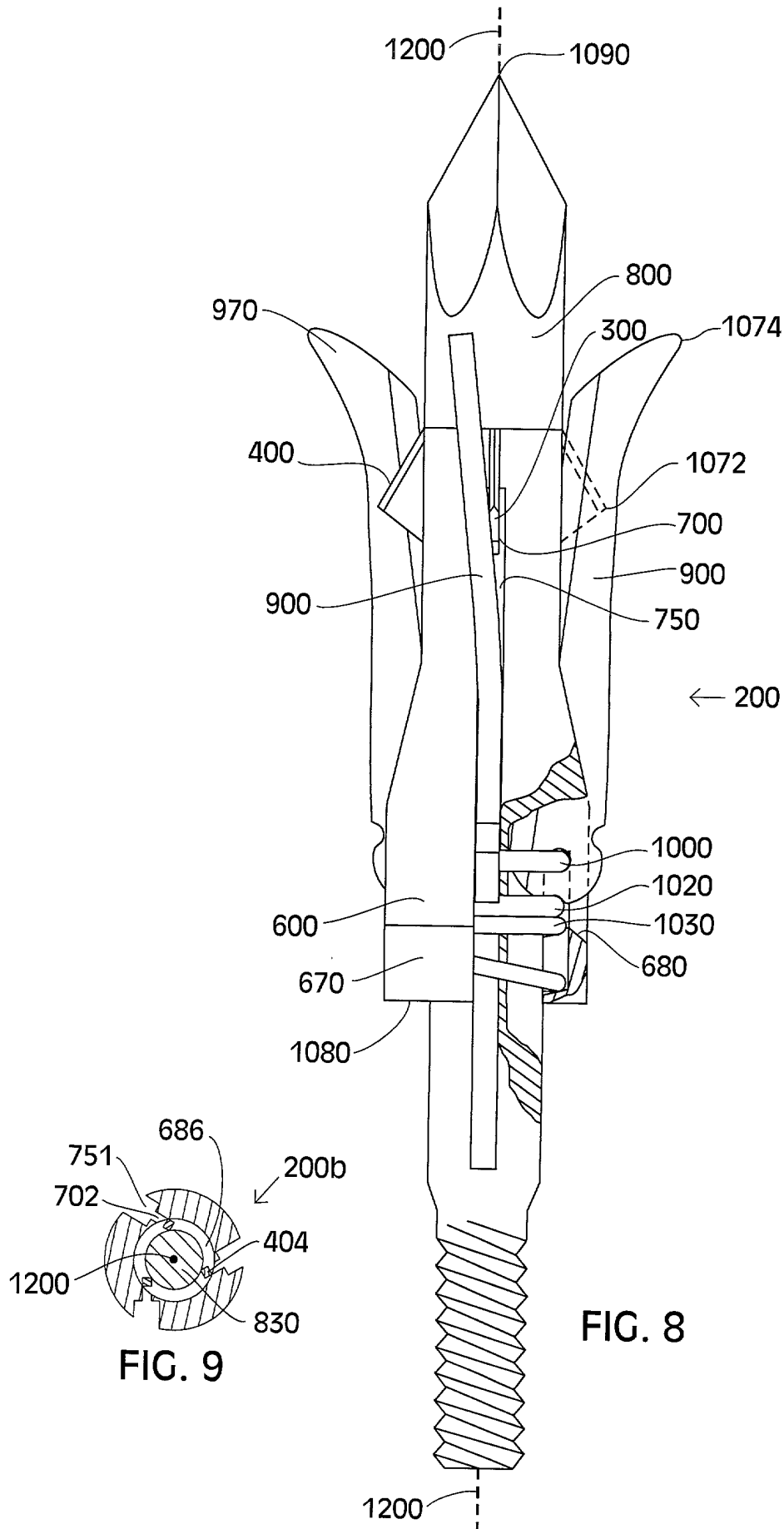


FIG. 8

FIG. 9

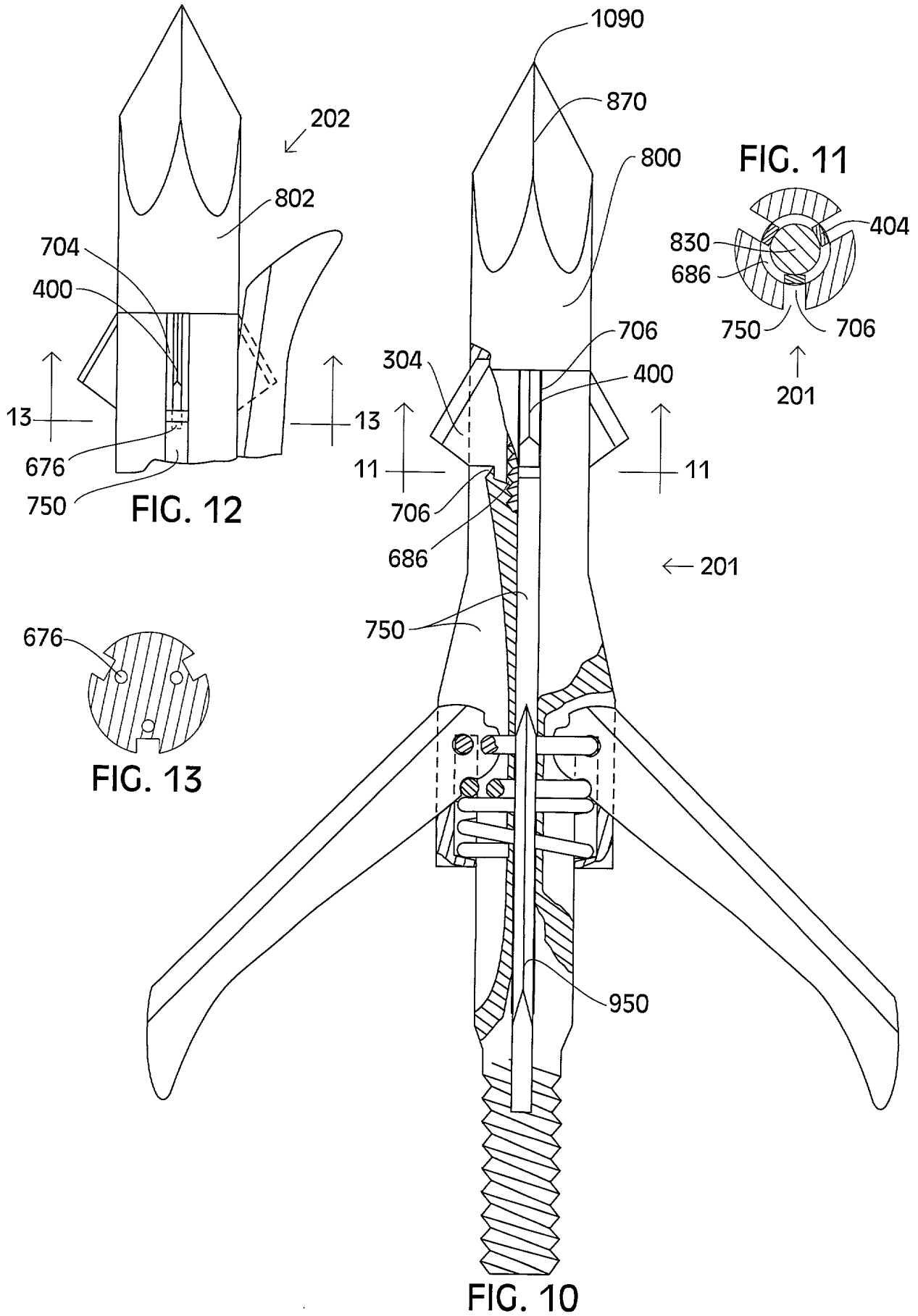


FIG. 14

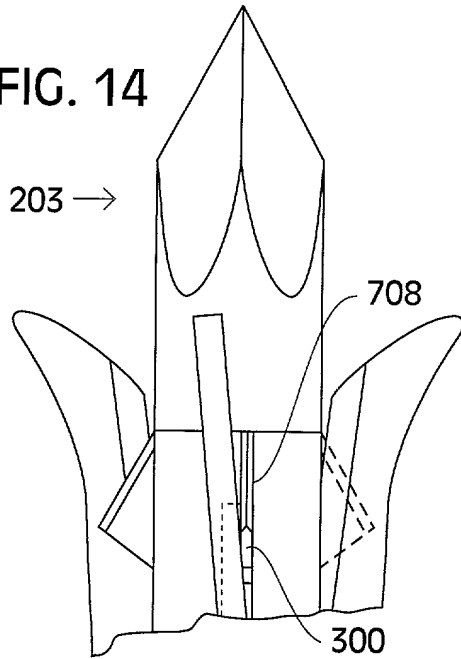


FIG. 17

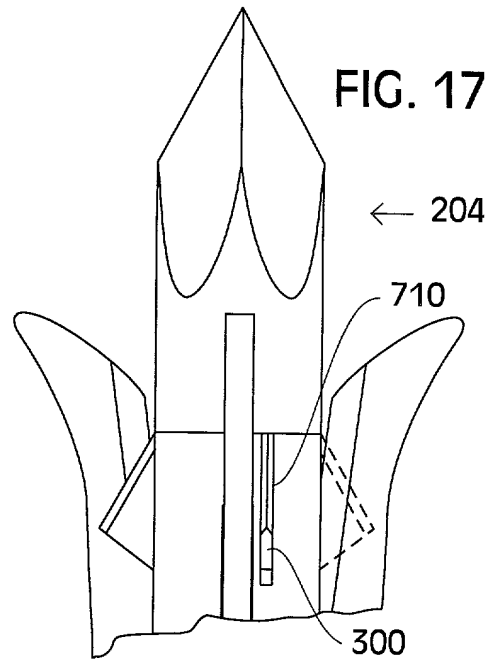


FIG. 15

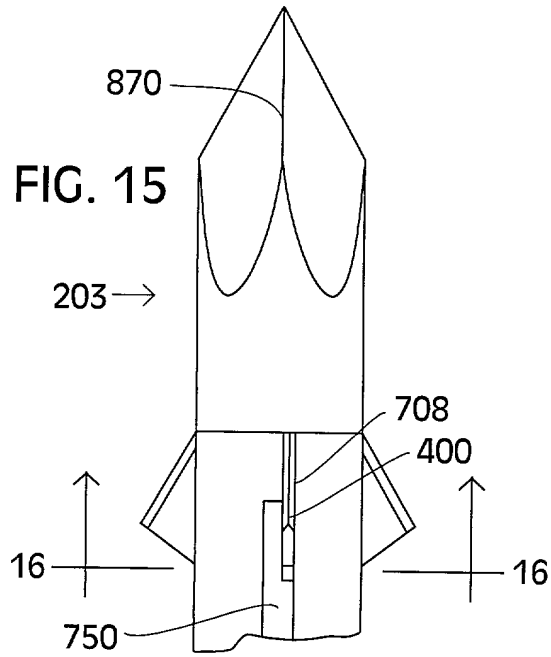


FIG. 18

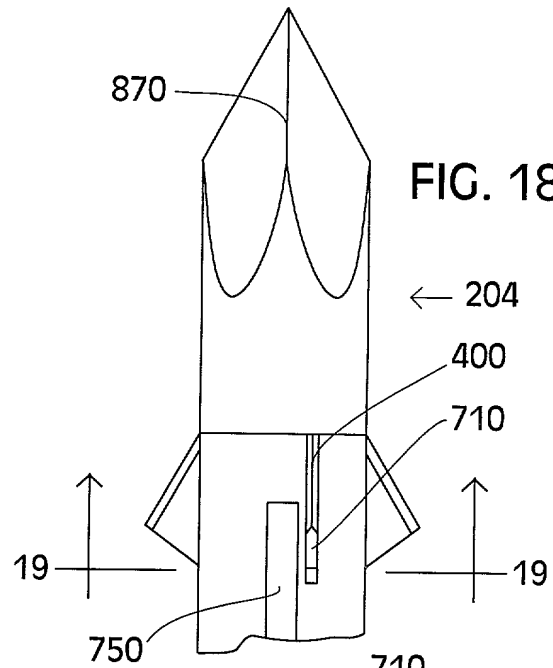


FIG. 16

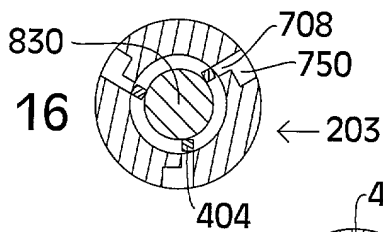


FIG. 19

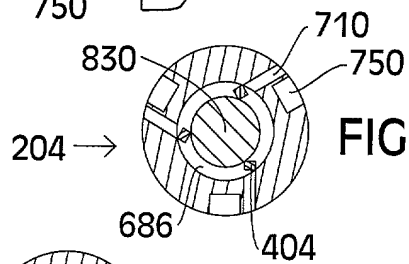


FIG. 21

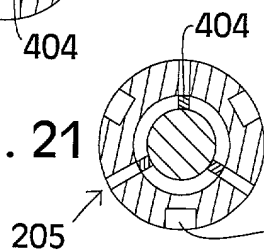
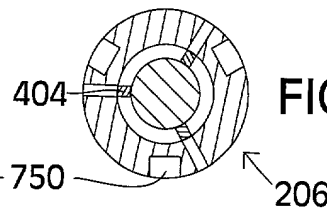


FIG. 20



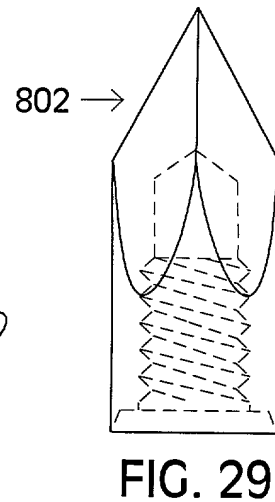
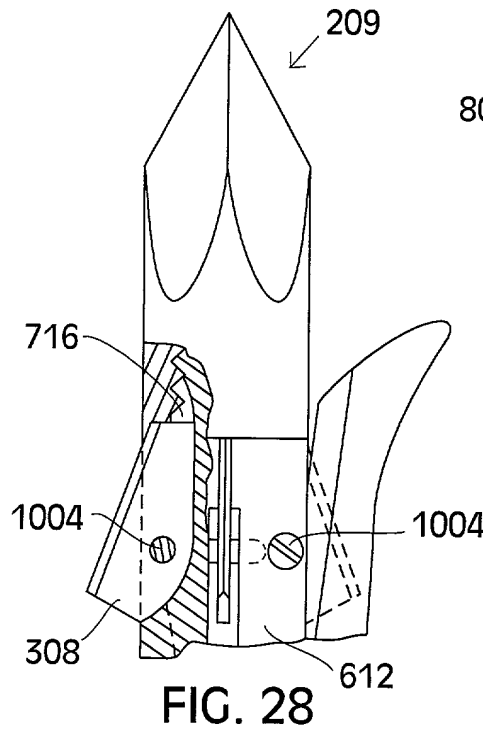
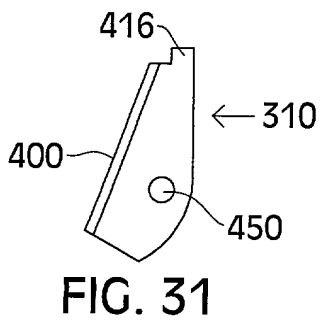
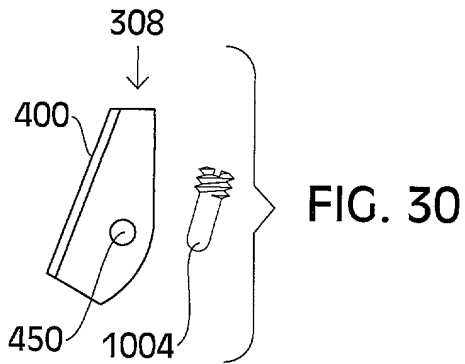
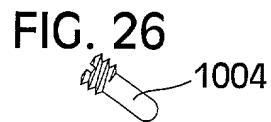
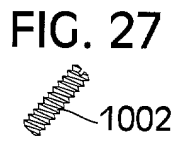
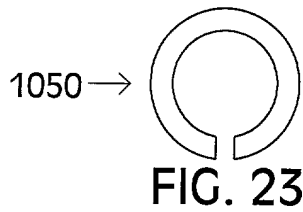
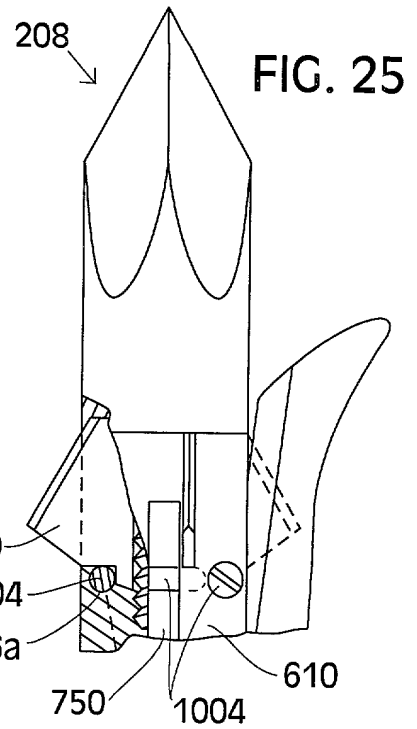
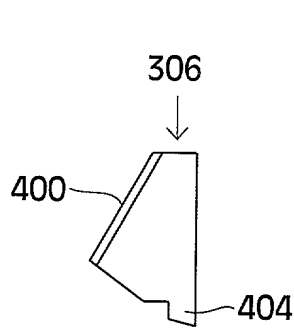
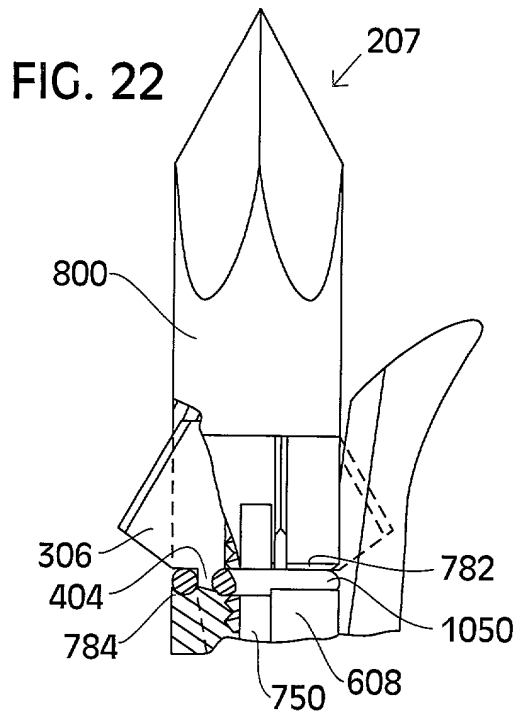


FIG. 39

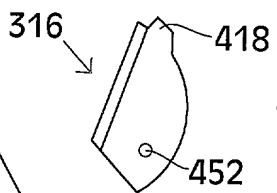


FIG. 37

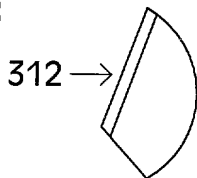


FIG. 36

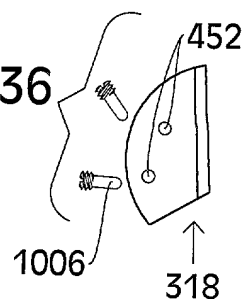


FIG. 38

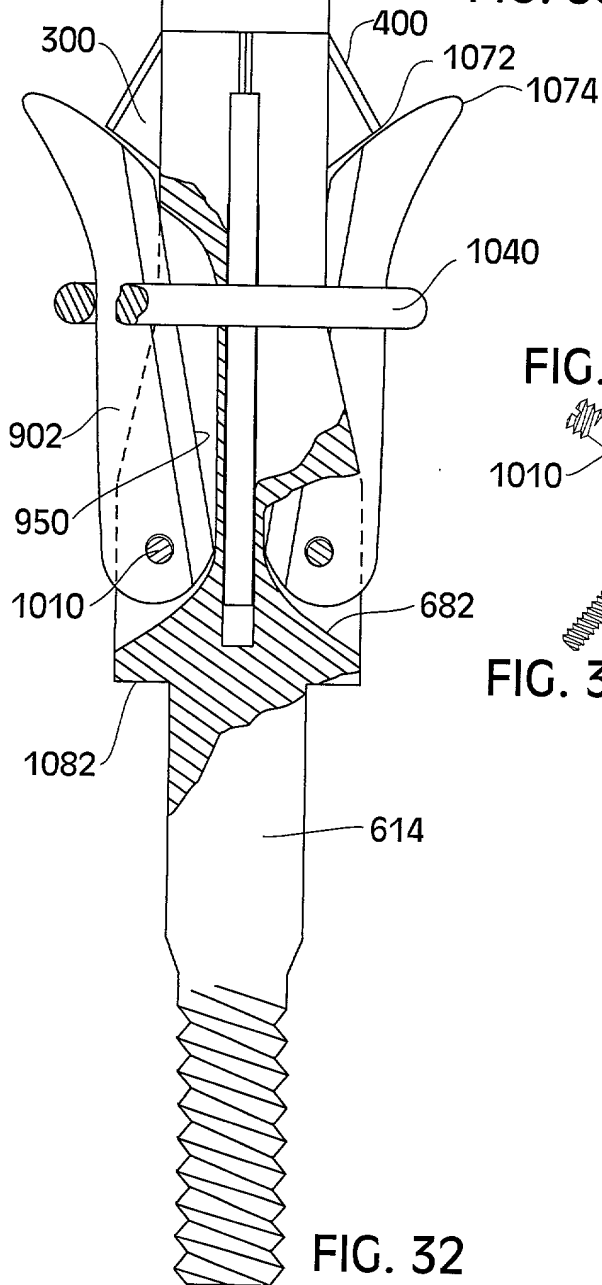


FIG. 33



FIG. 34

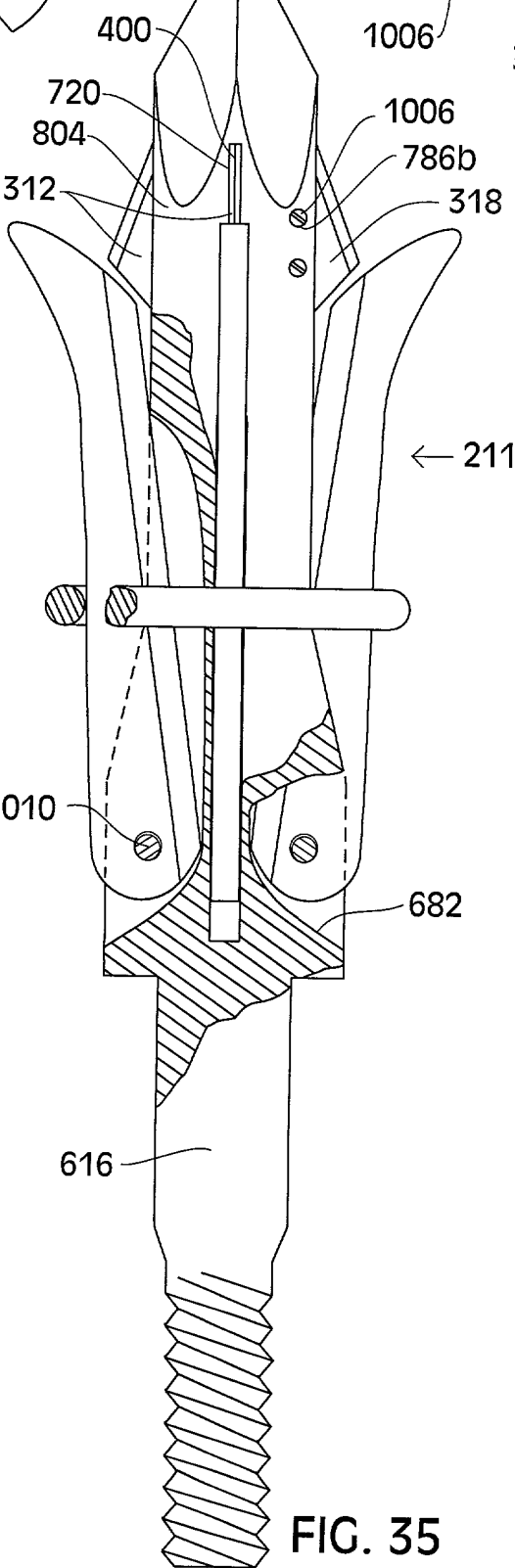


FIG. 35

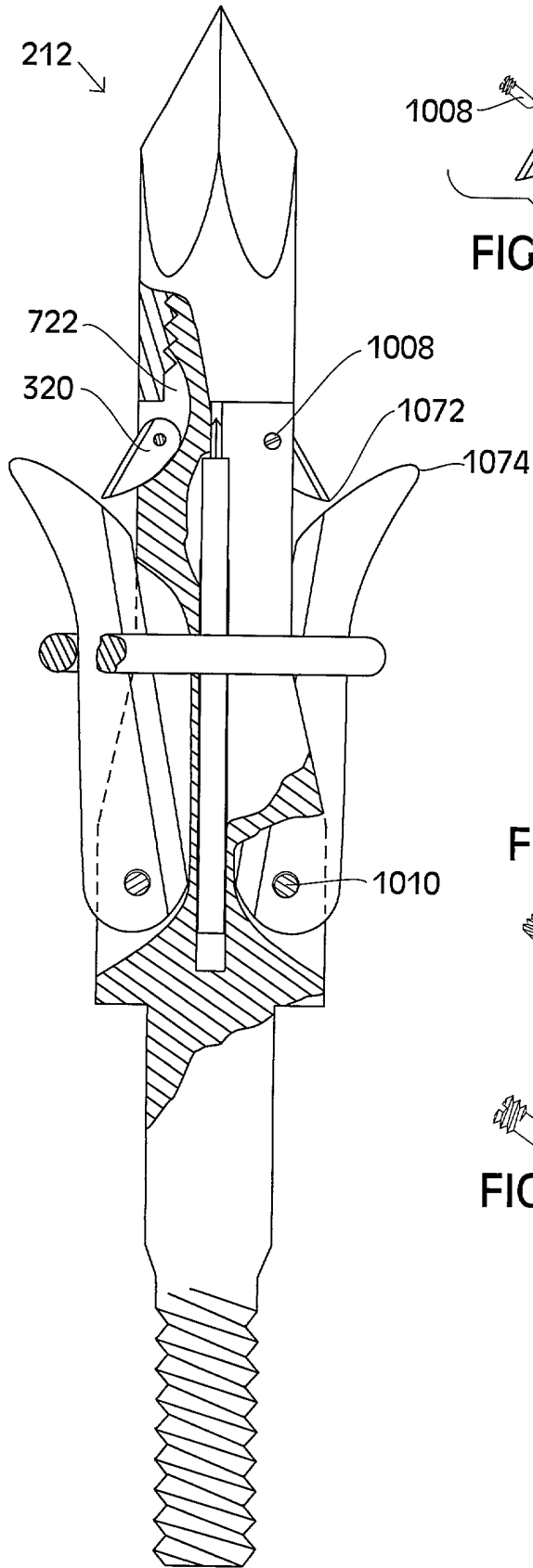


FIG. 40

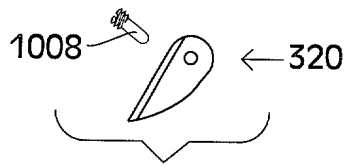


FIG. 43

FIG. 41



FIG. 42

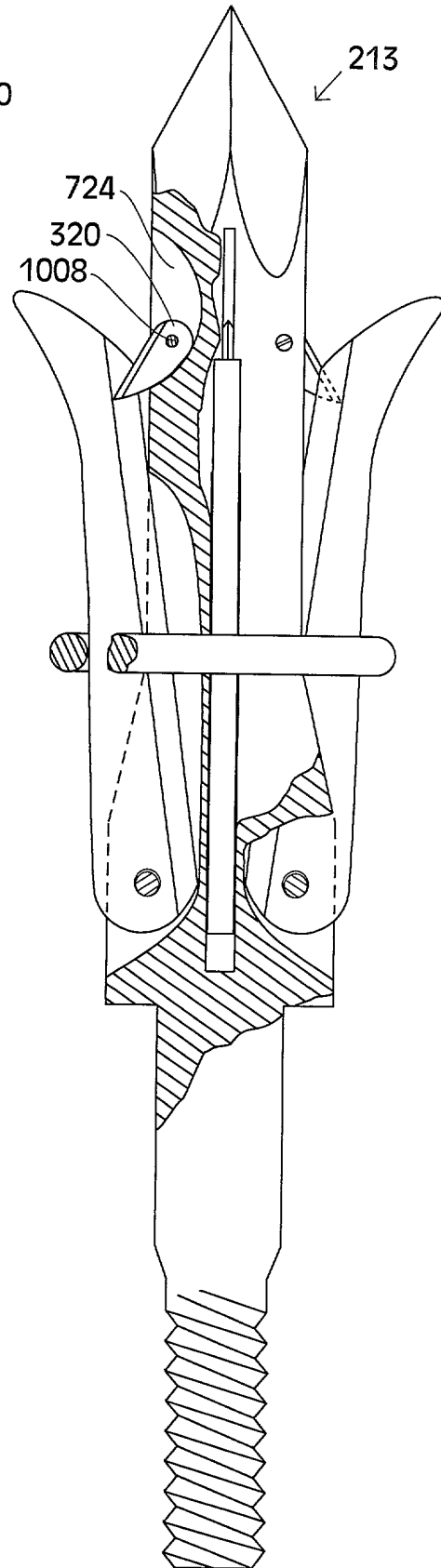
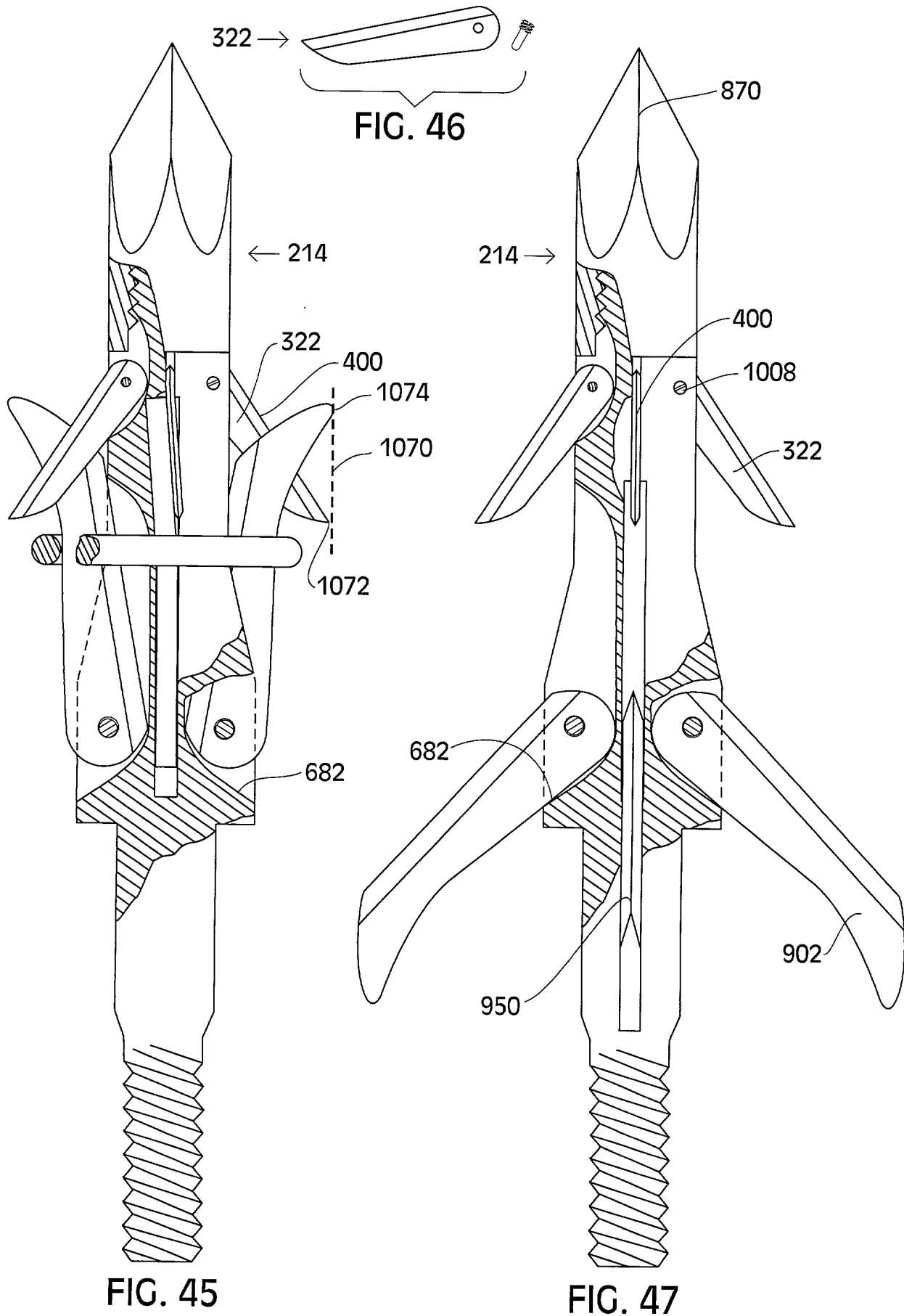


FIG. 44





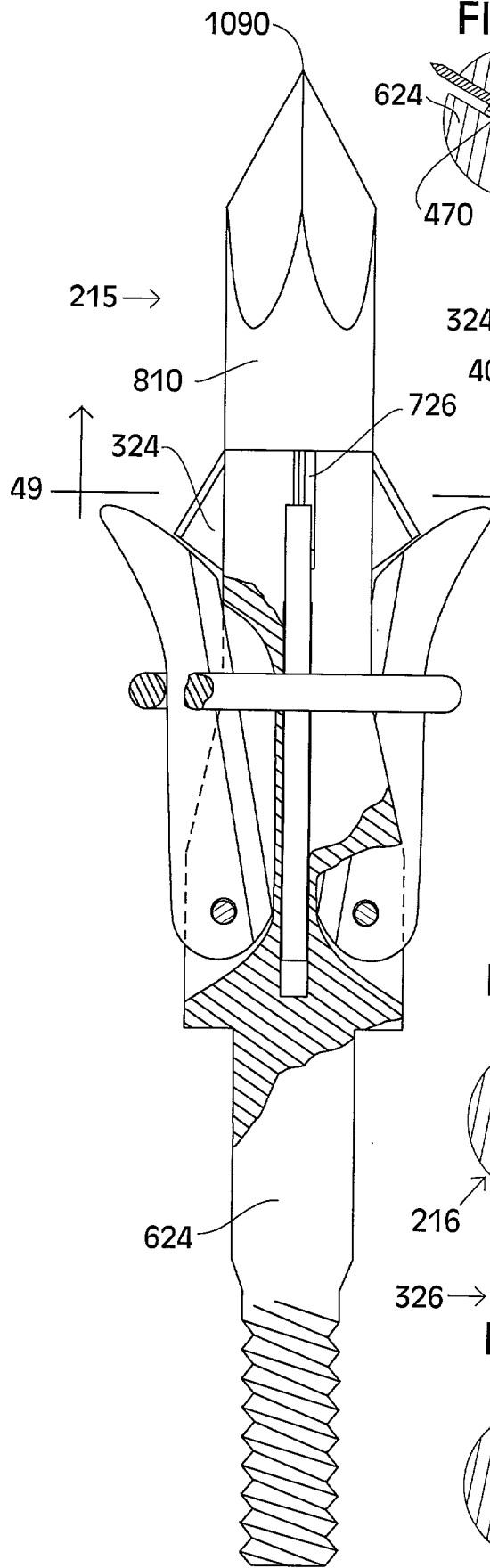


FIG. 48

FIG. 49

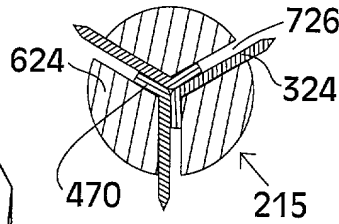


FIG. 50

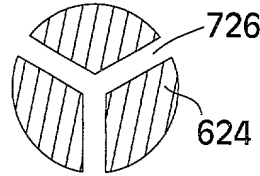


FIG. 53

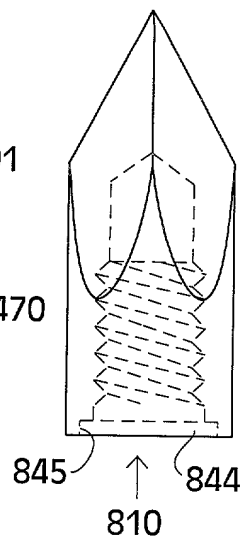


FIG. 54

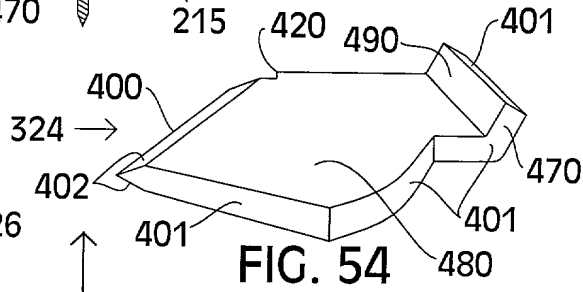


FIG. 52



FIG. 51

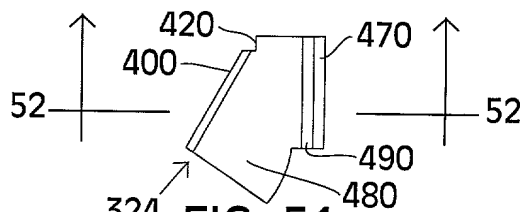


FIG. 55

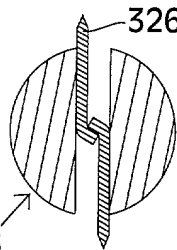


FIG. 58

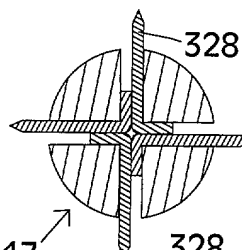


FIG. 61

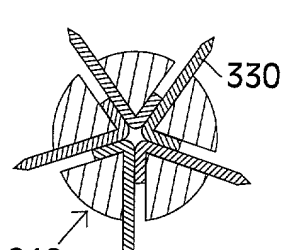


FIG. 56



FIG. 59



FIG. 62

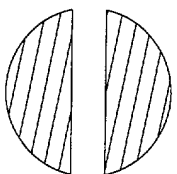


FIG. 57

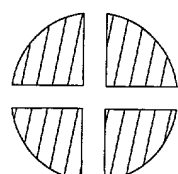


FIG. 60

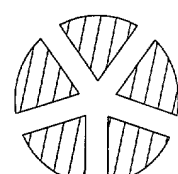
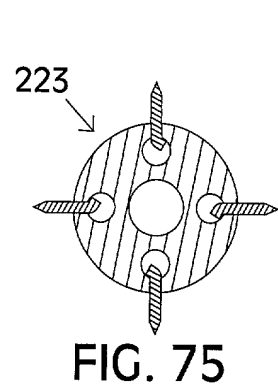
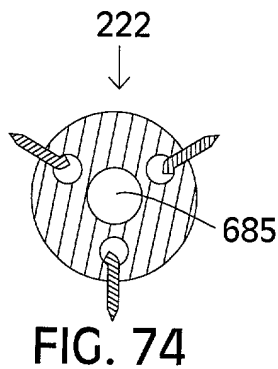
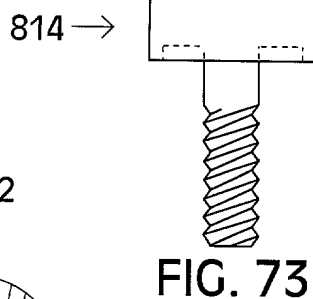
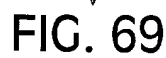
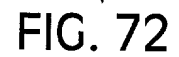
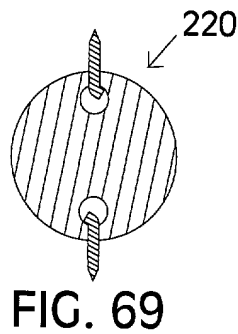
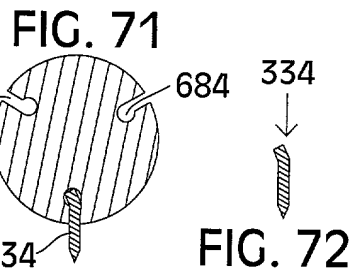
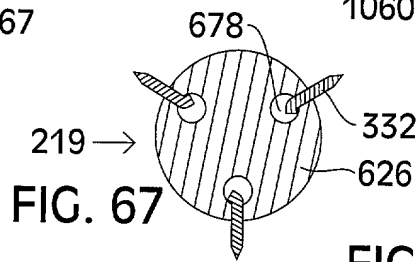
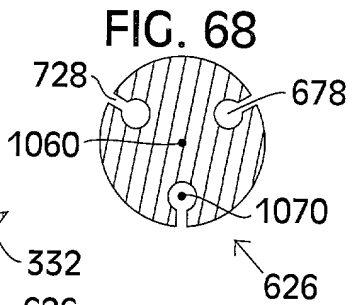
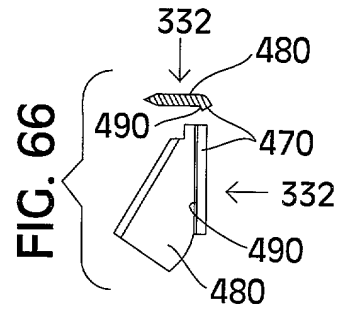
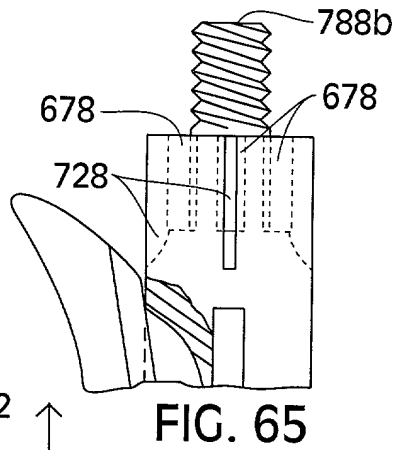
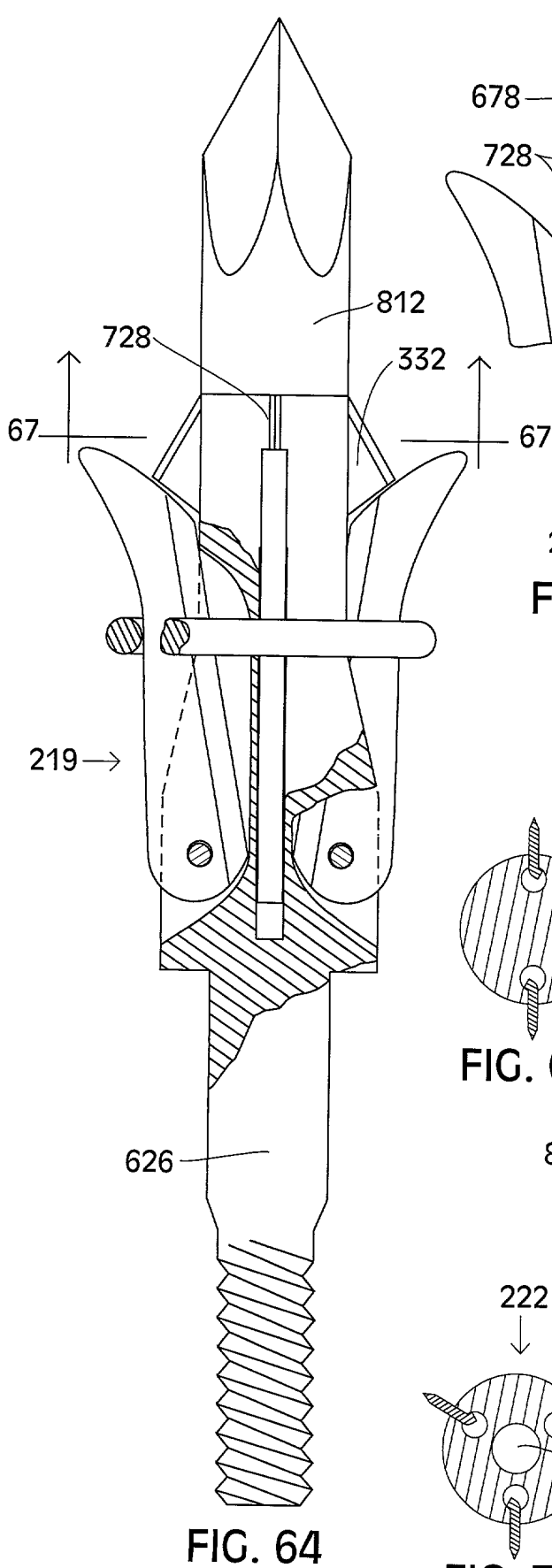
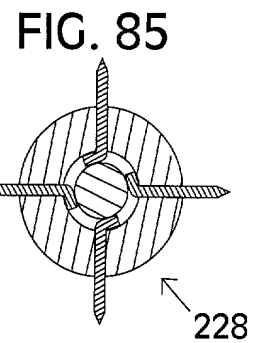
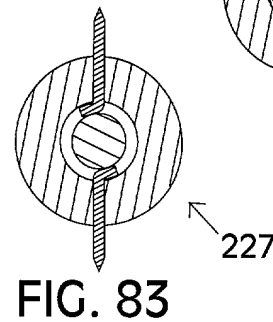
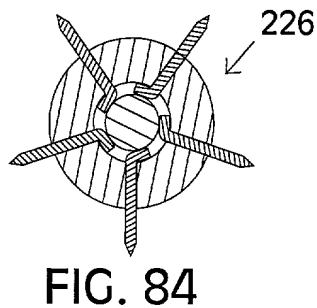
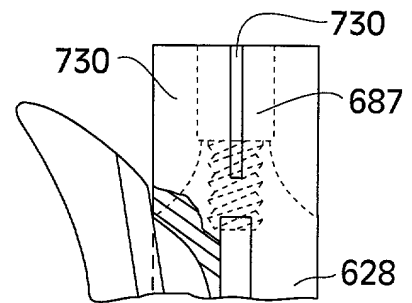
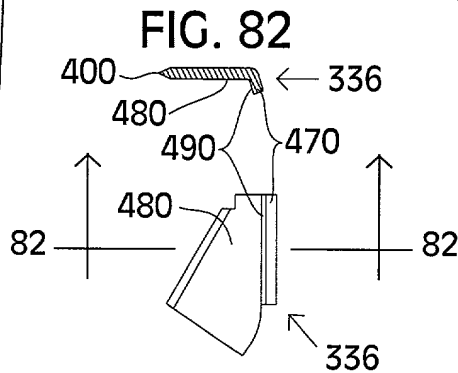
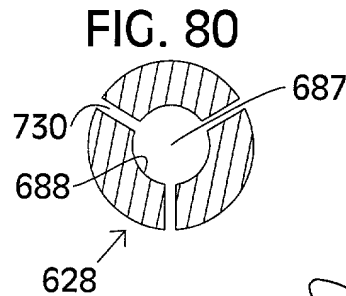
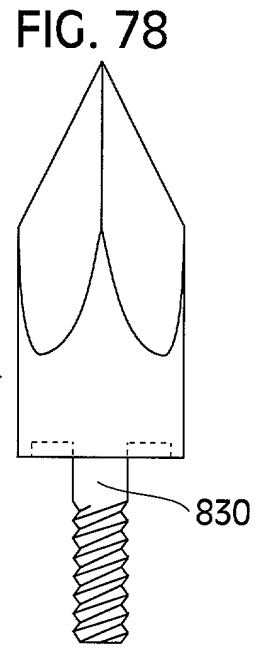
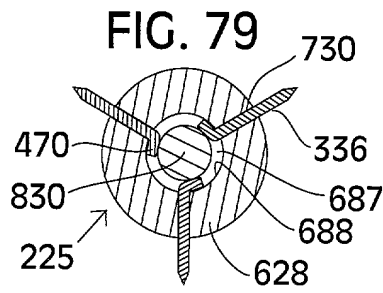
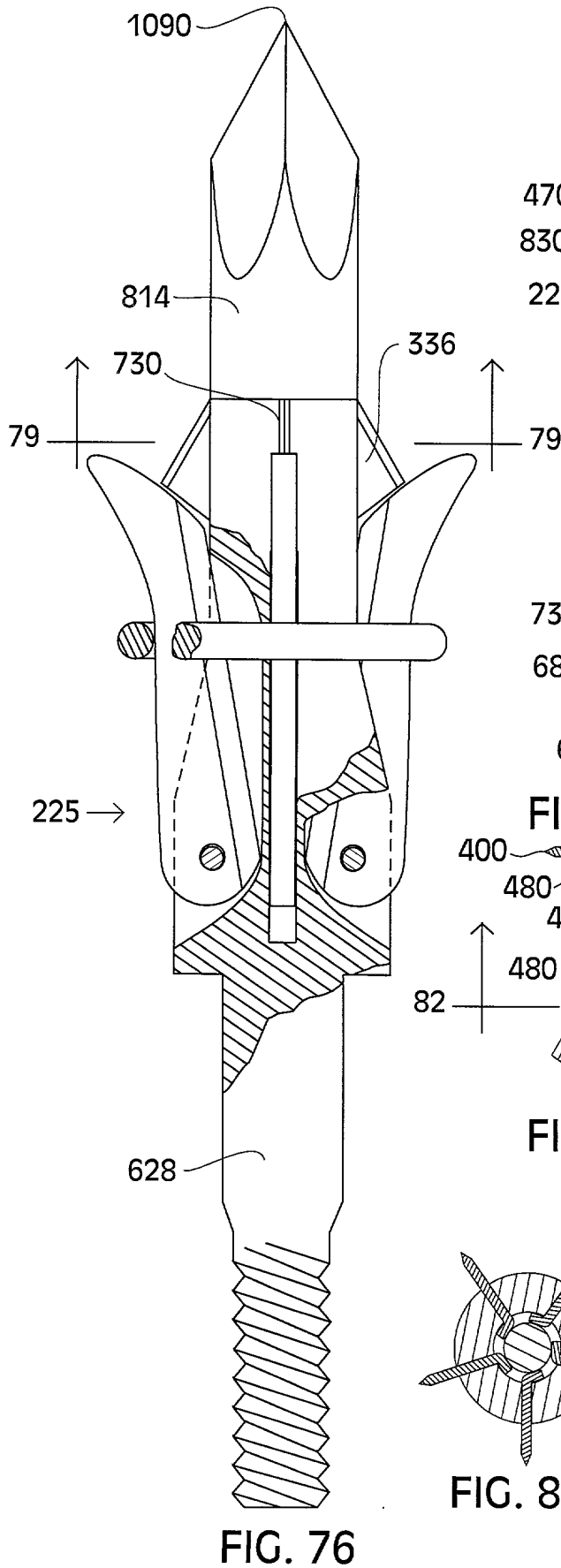


FIG. 63





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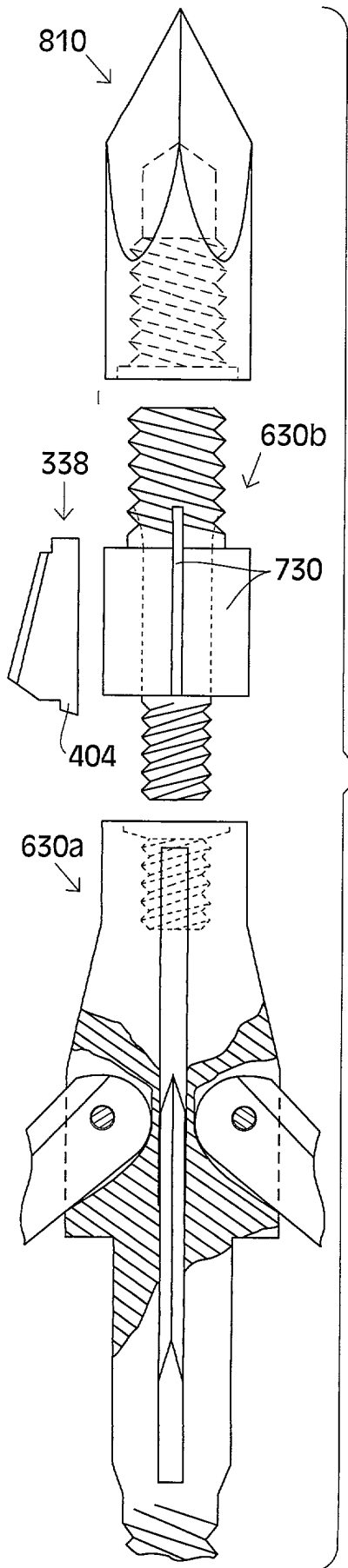


FIG. 87

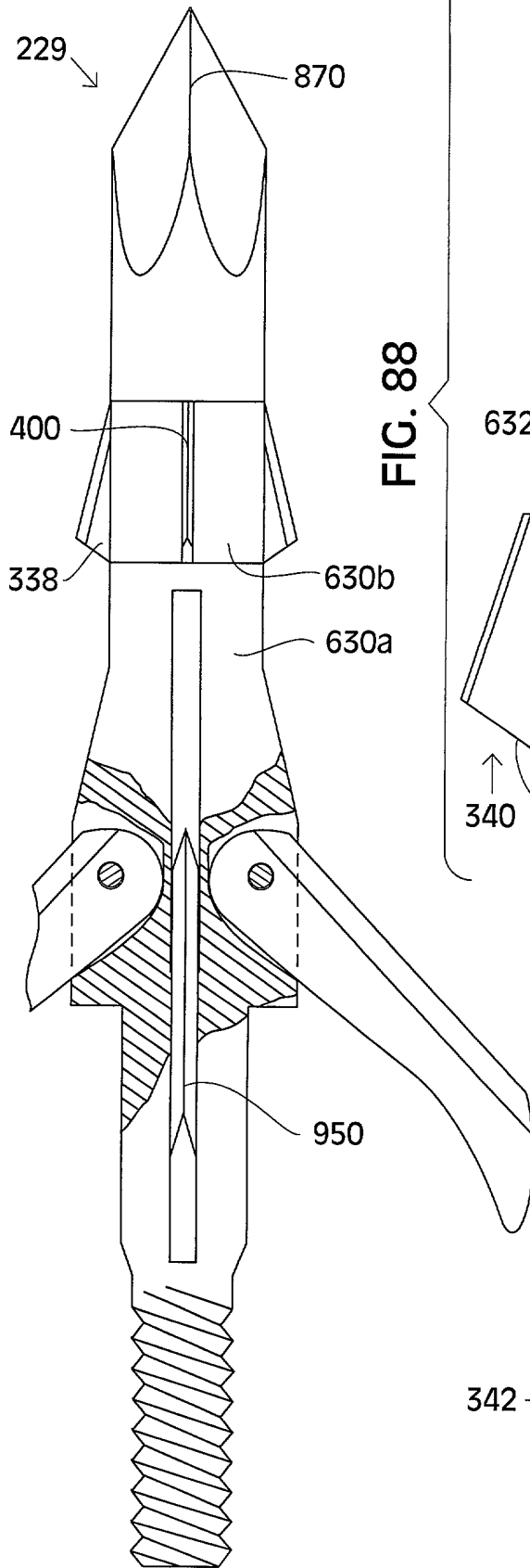


FIG. 86

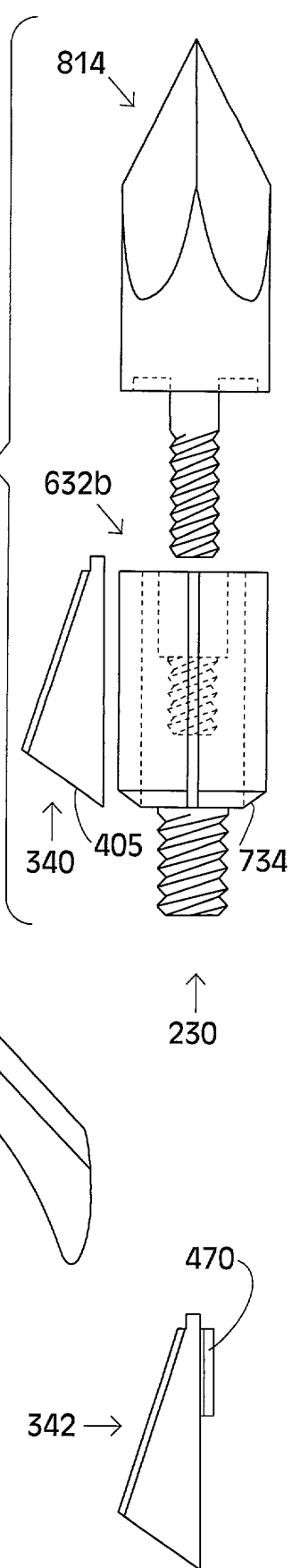


FIG. 88

FIG. 89

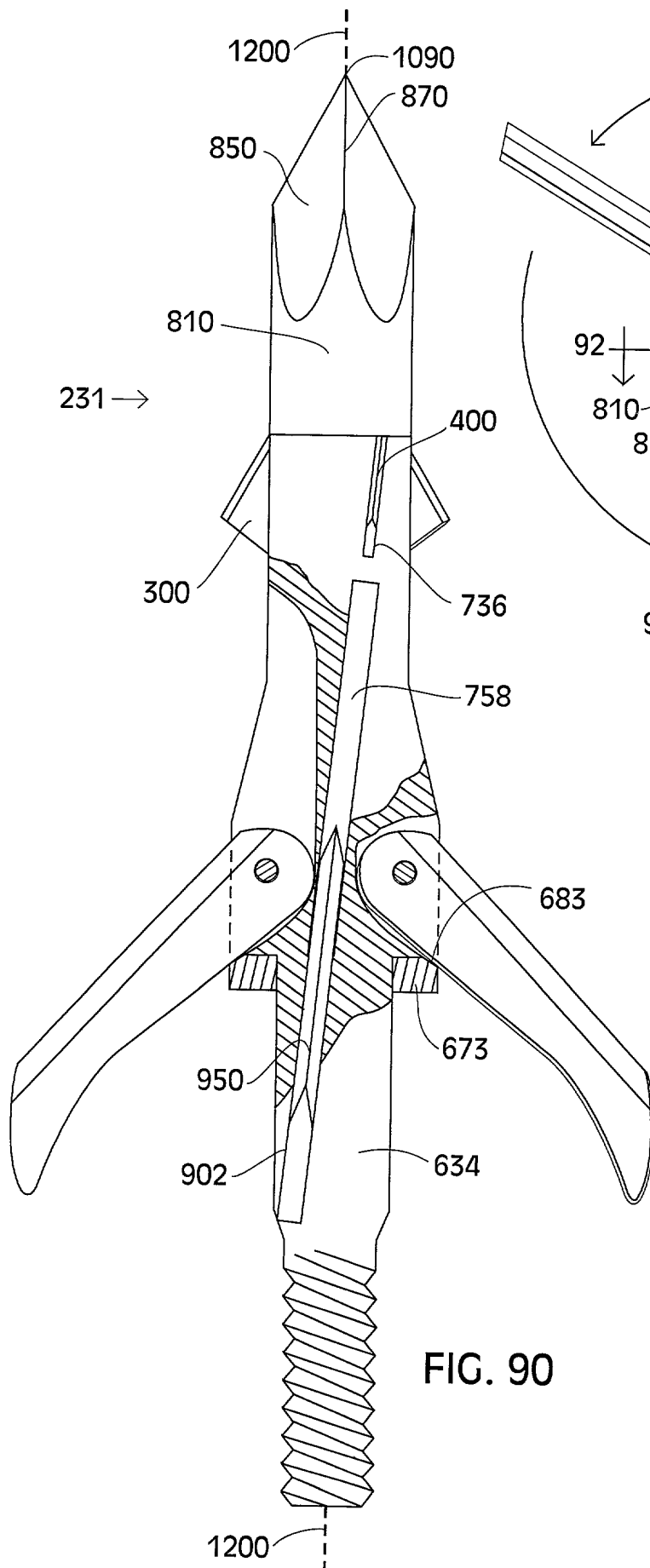


FIG. 90

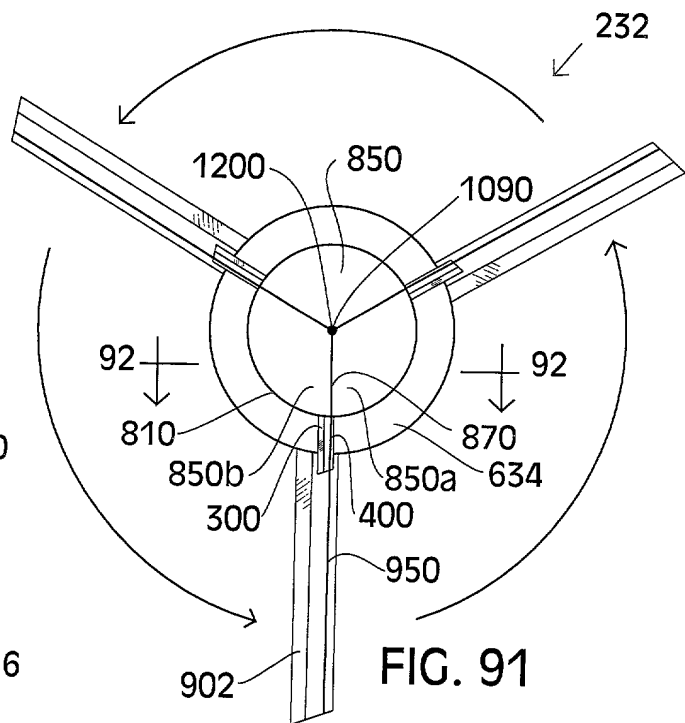


FIG. 91

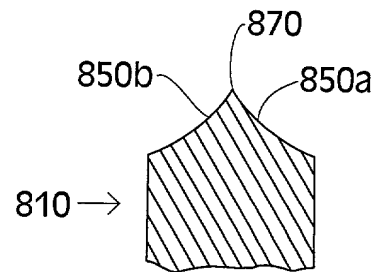


FIG. 92

FIG. 93

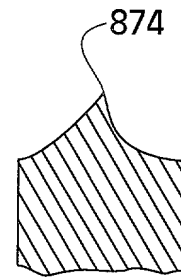
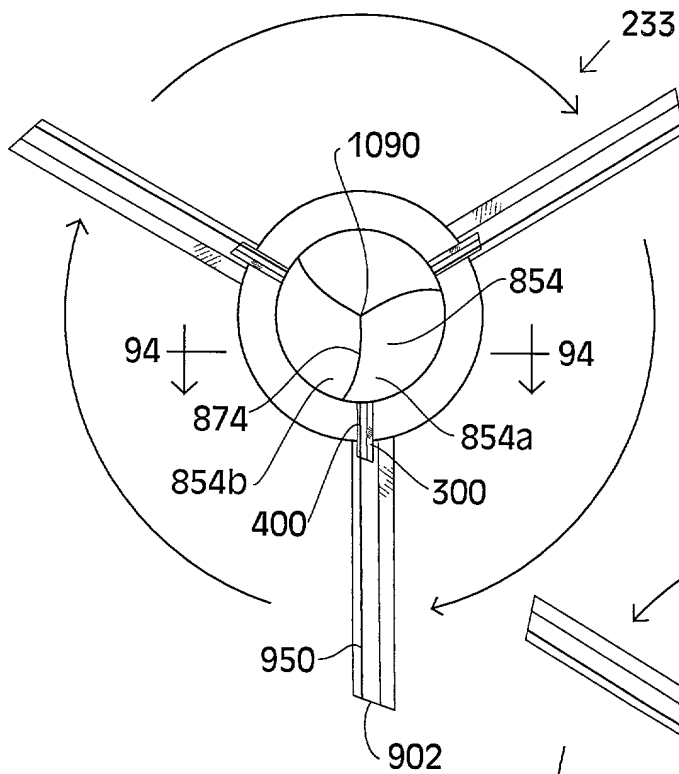


FIG. 95

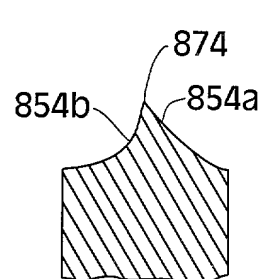


FIG. 94

FIG. 96

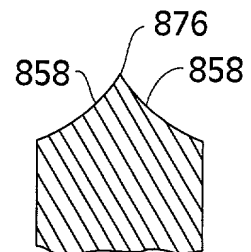
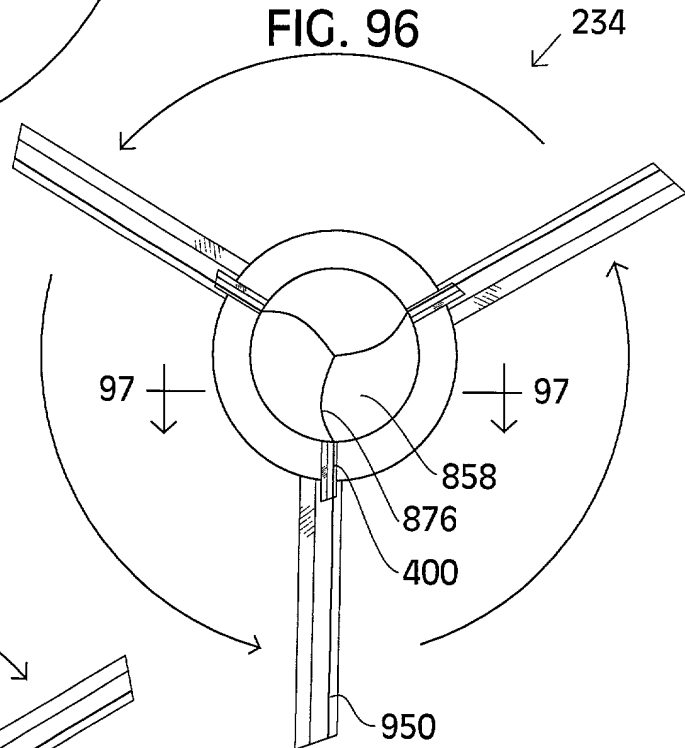


FIG. 97

FIG. 98

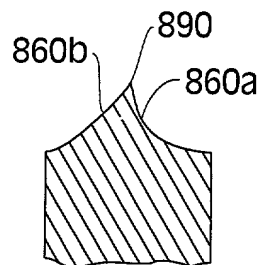
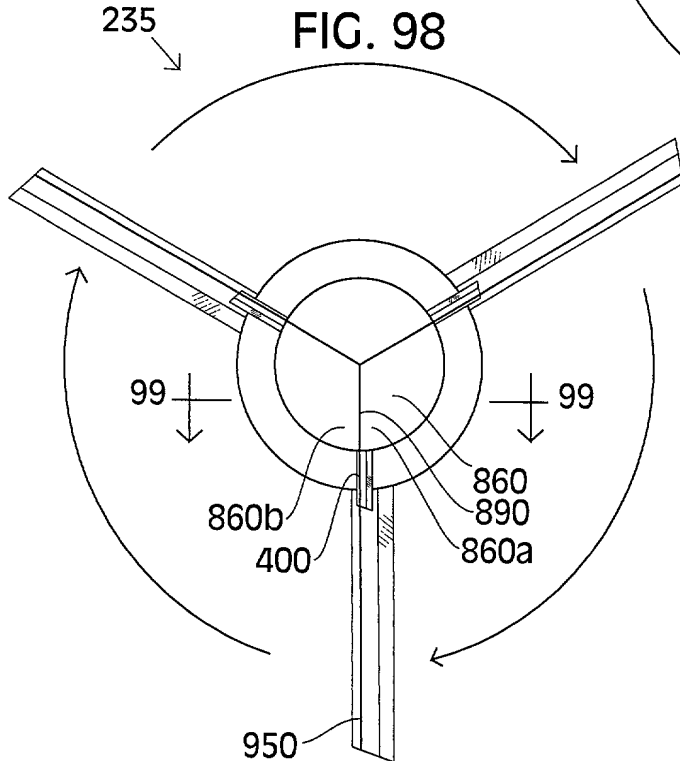


FIG. 99

FIG. 100

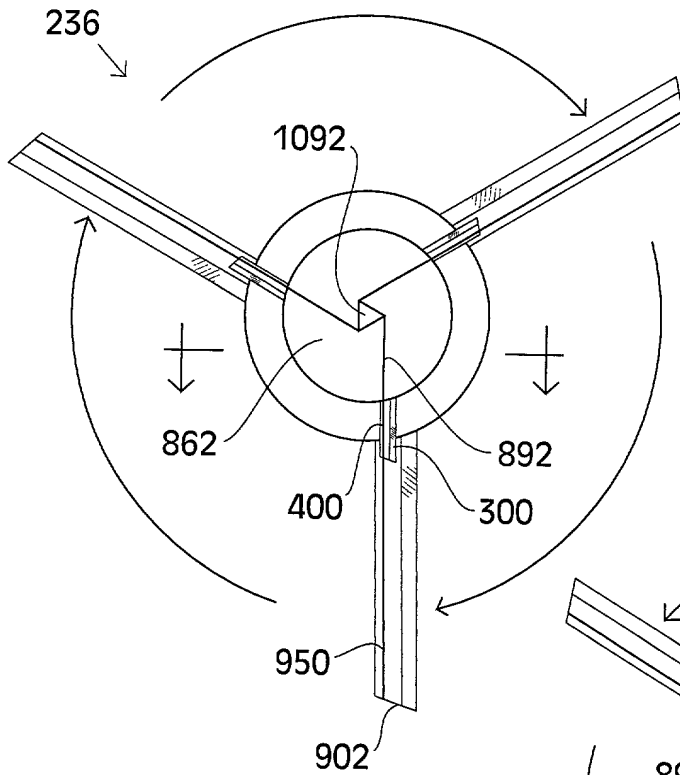


FIG. 101

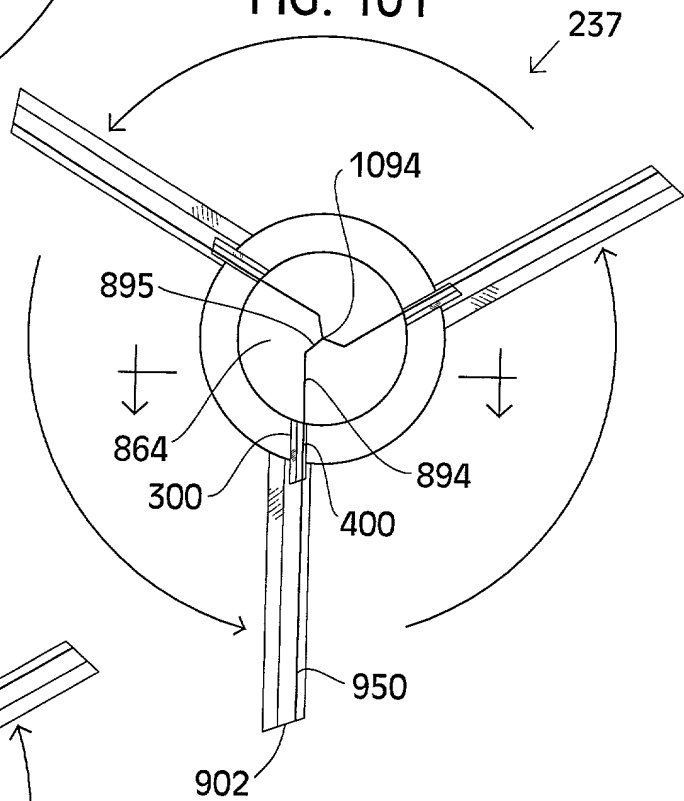


FIG. 102

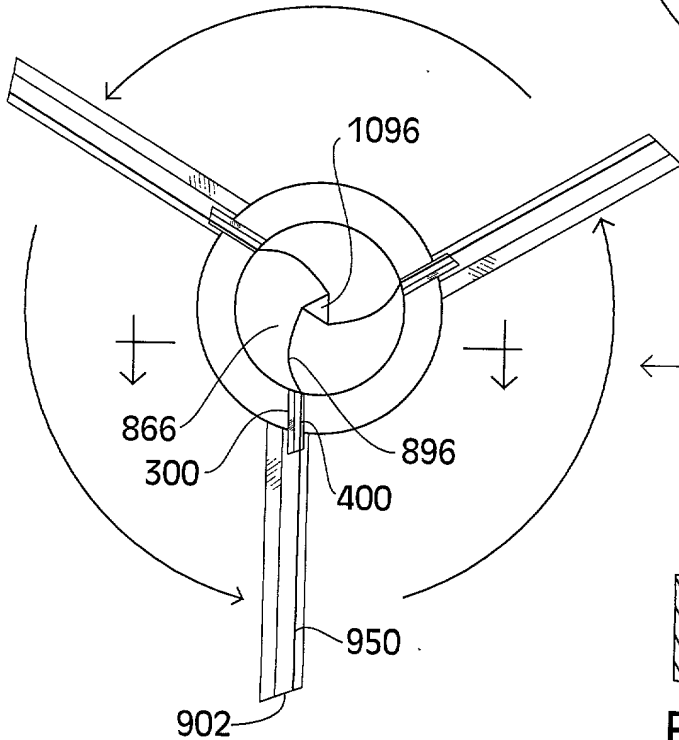


FIG. 103

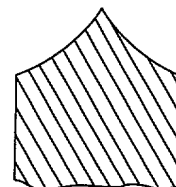


FIG. 104

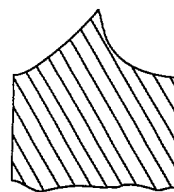
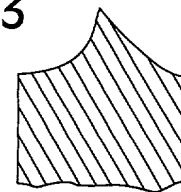


FIG. 105





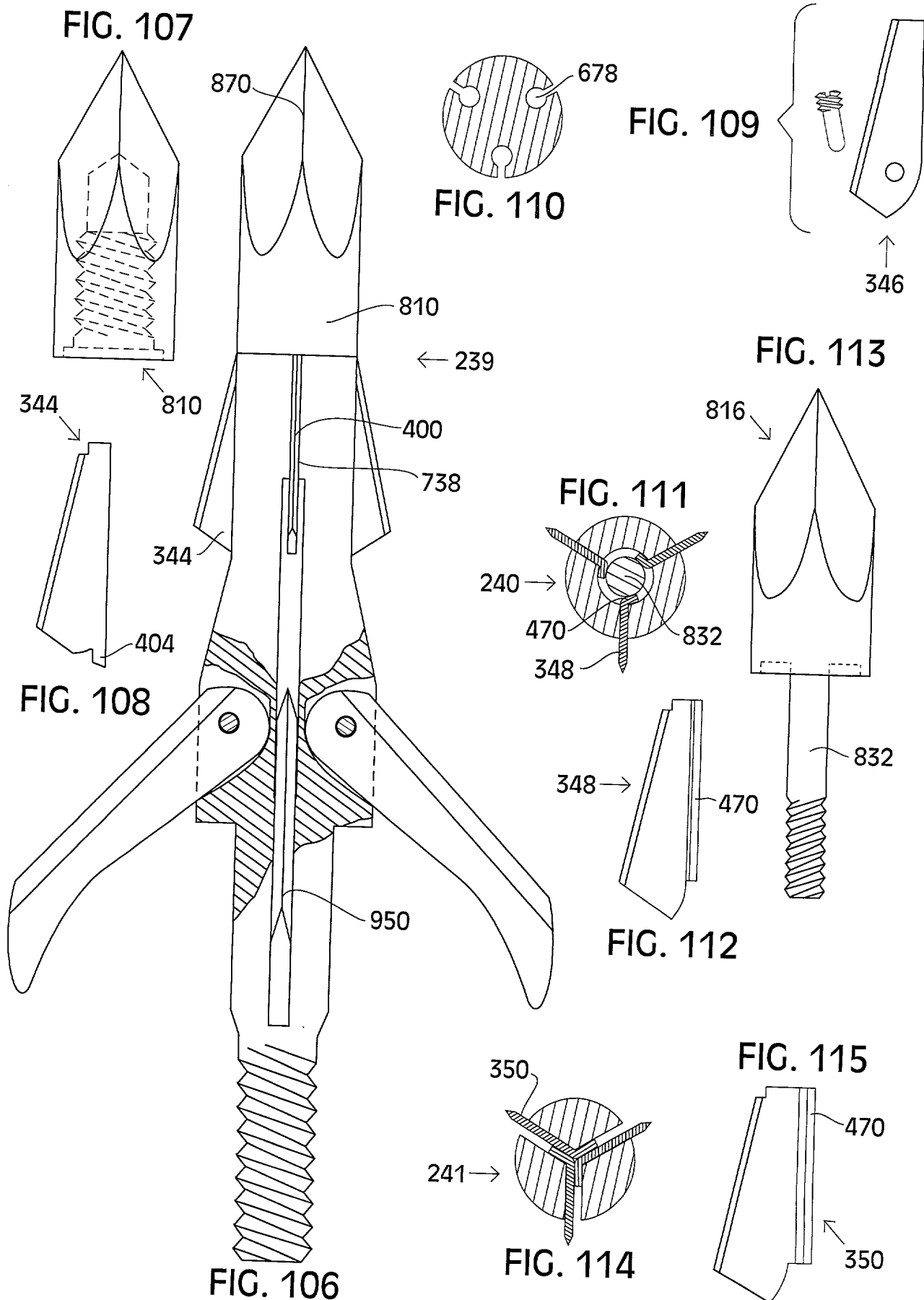


FIG. 116

FIG. 121

FIG. 118

352

358 →

← 360

← 242

FIG. 122

FIG. 120

FIG. 117

FIG. 123

760a

760b

243

362 →

FIG. 124 FIG. 125

400a

356 →

400b

404

FIG. 119

FIG. 126

244

366 →

FIG. 127 FIG. 128

470

470

368

653250-2000000

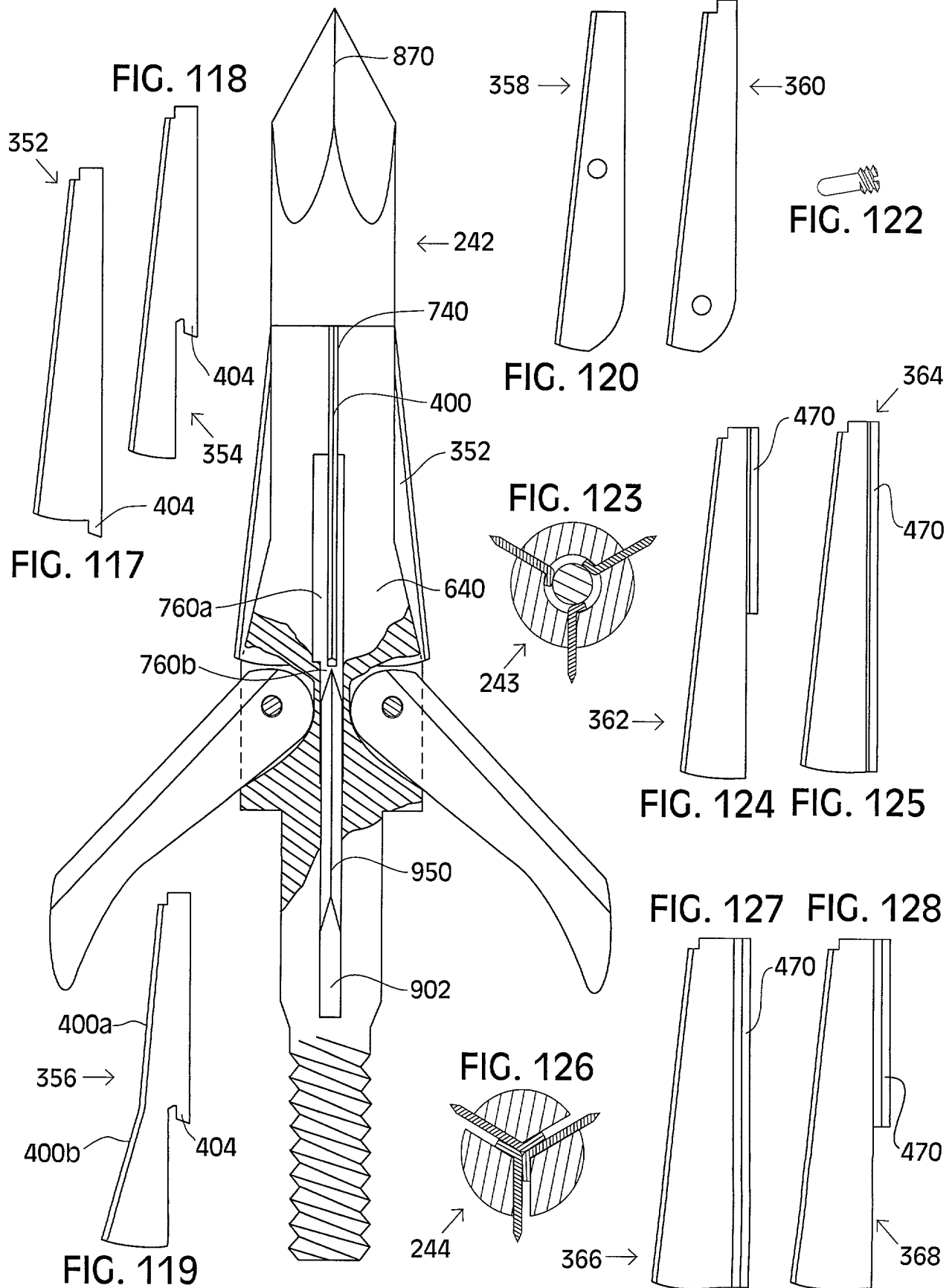
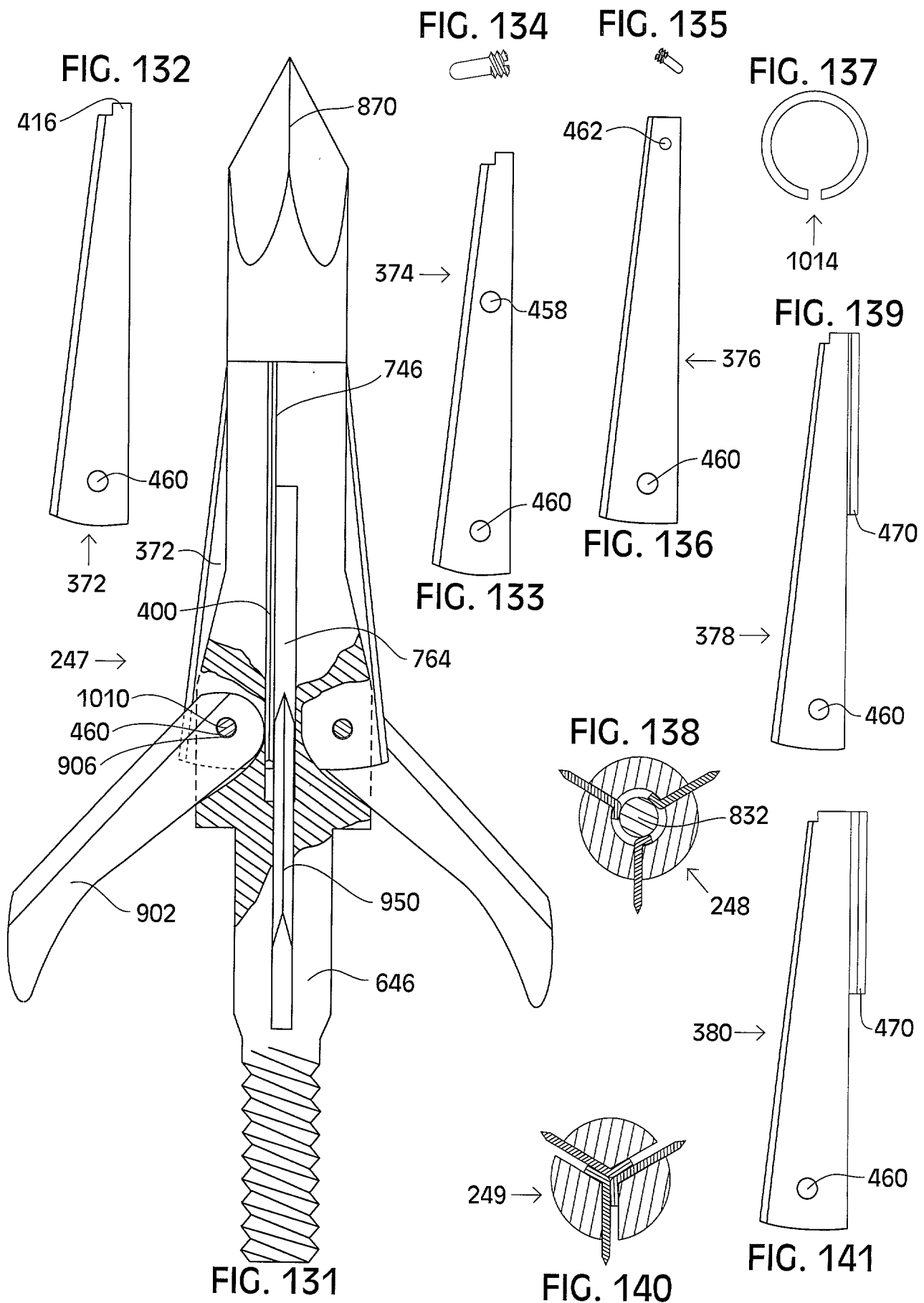




FIG. 129



FIG. 130



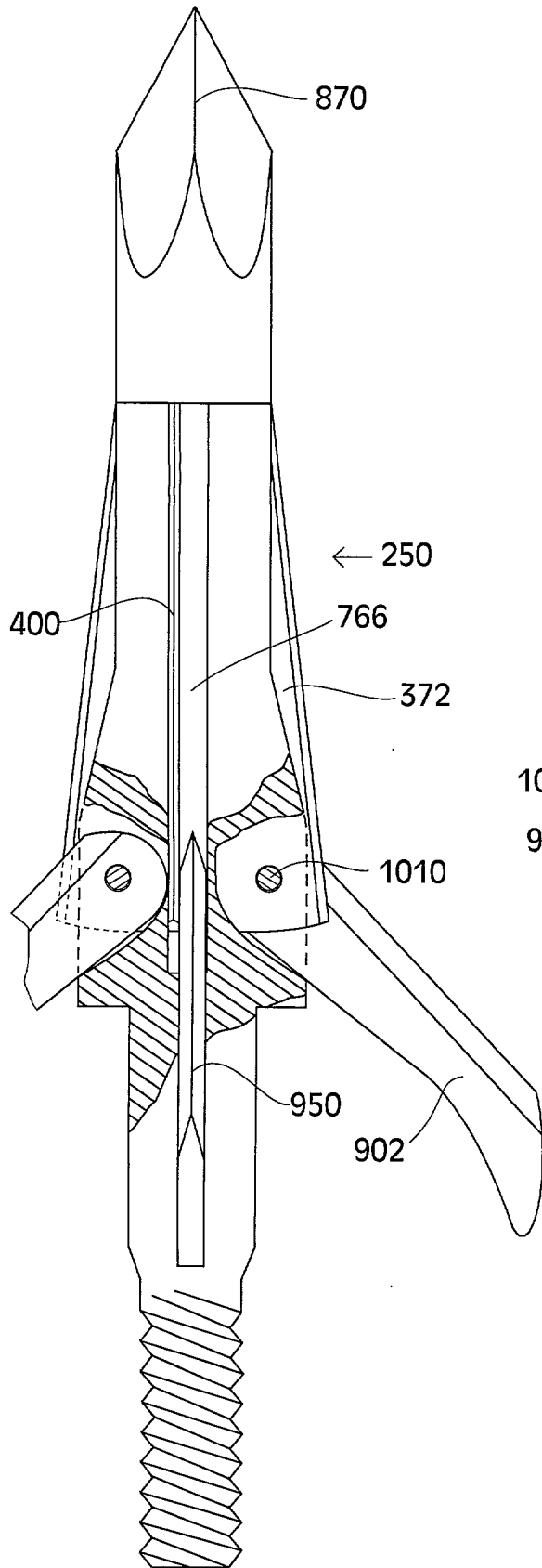


FIG. 142

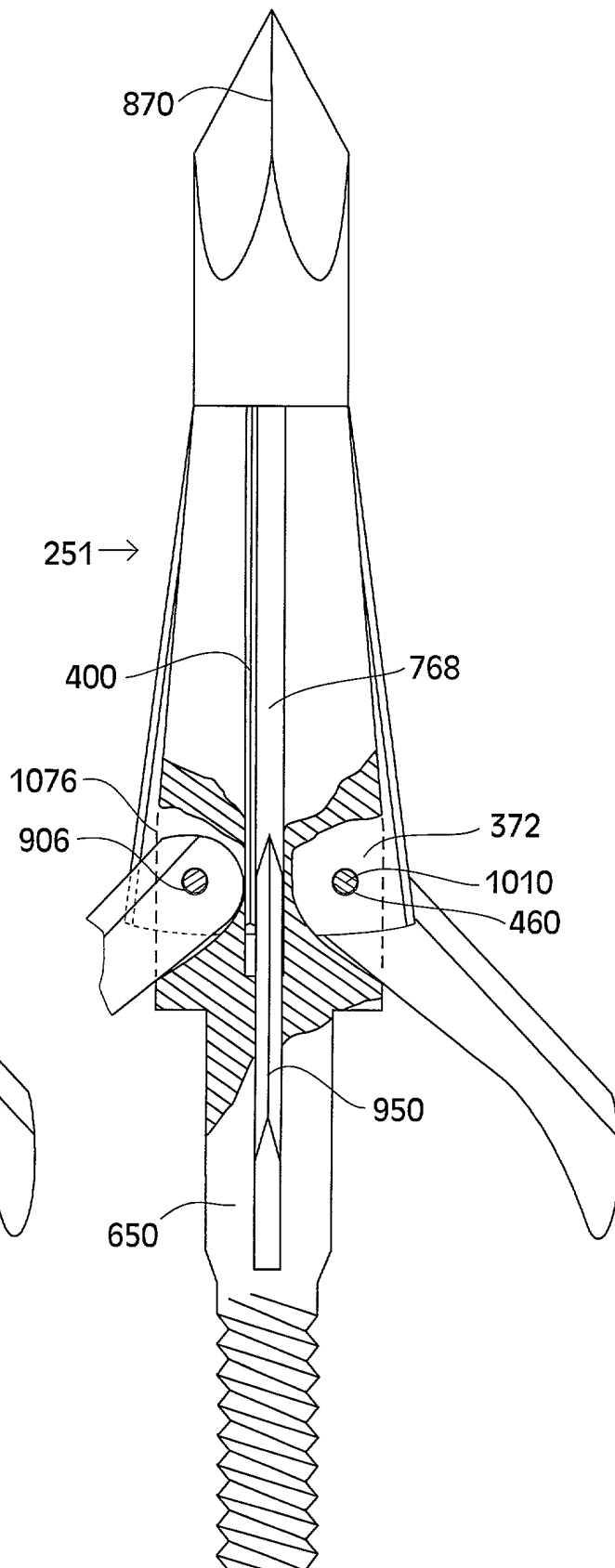


FIG. 143

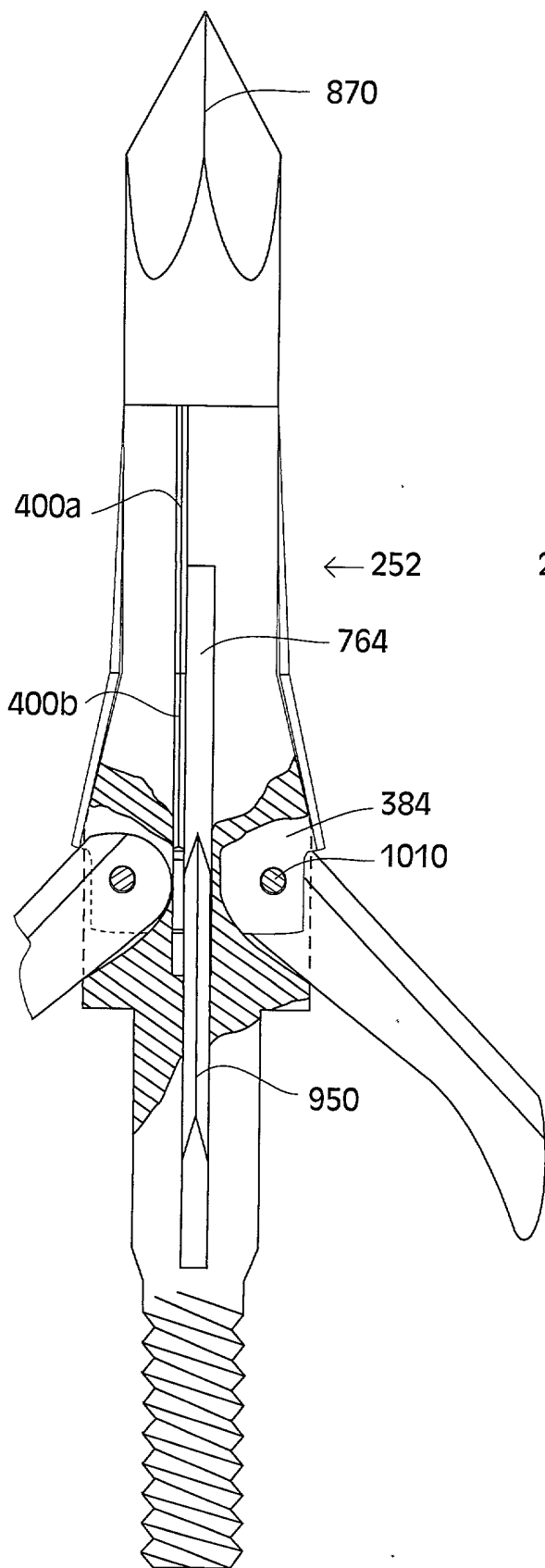


FIG. 144

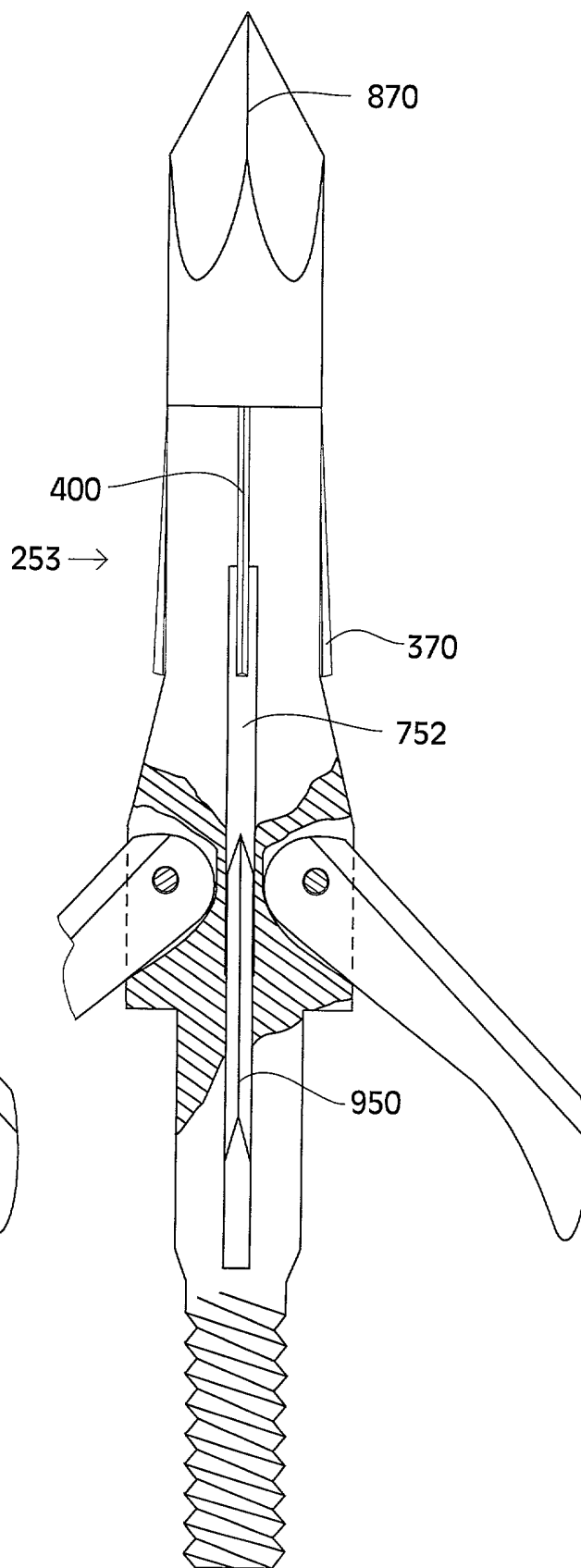


FIG. 145

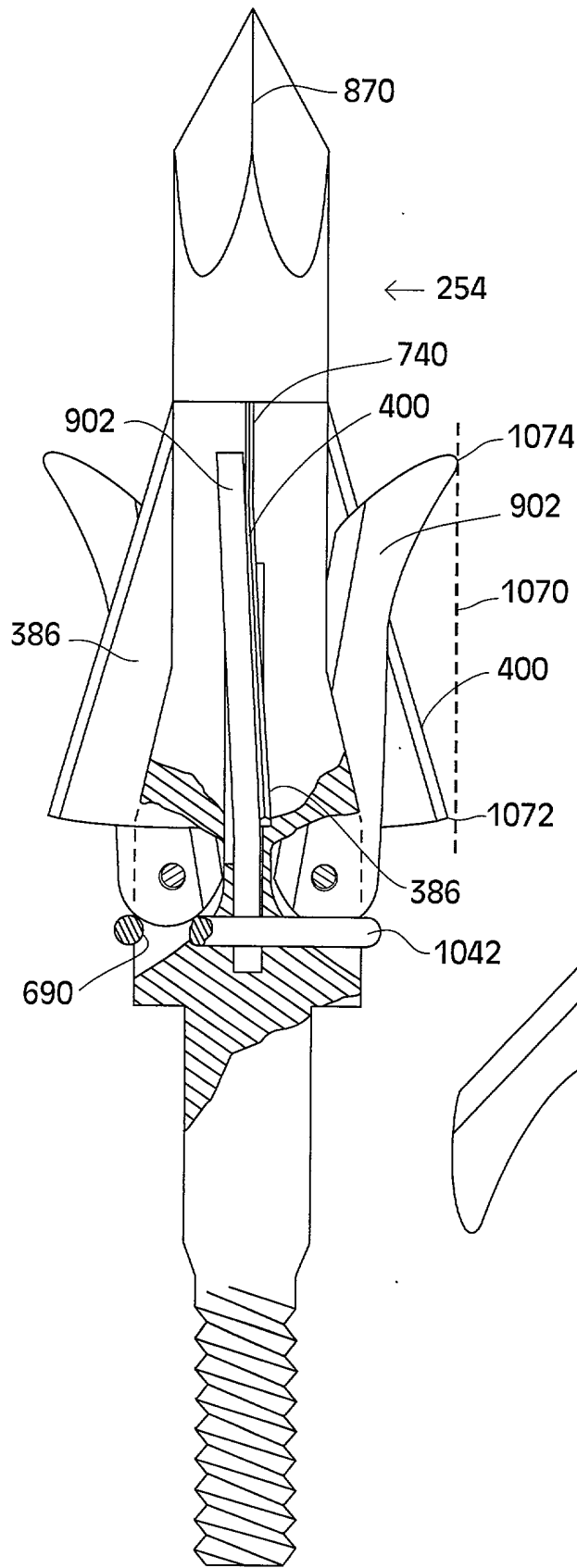


FIG. 146

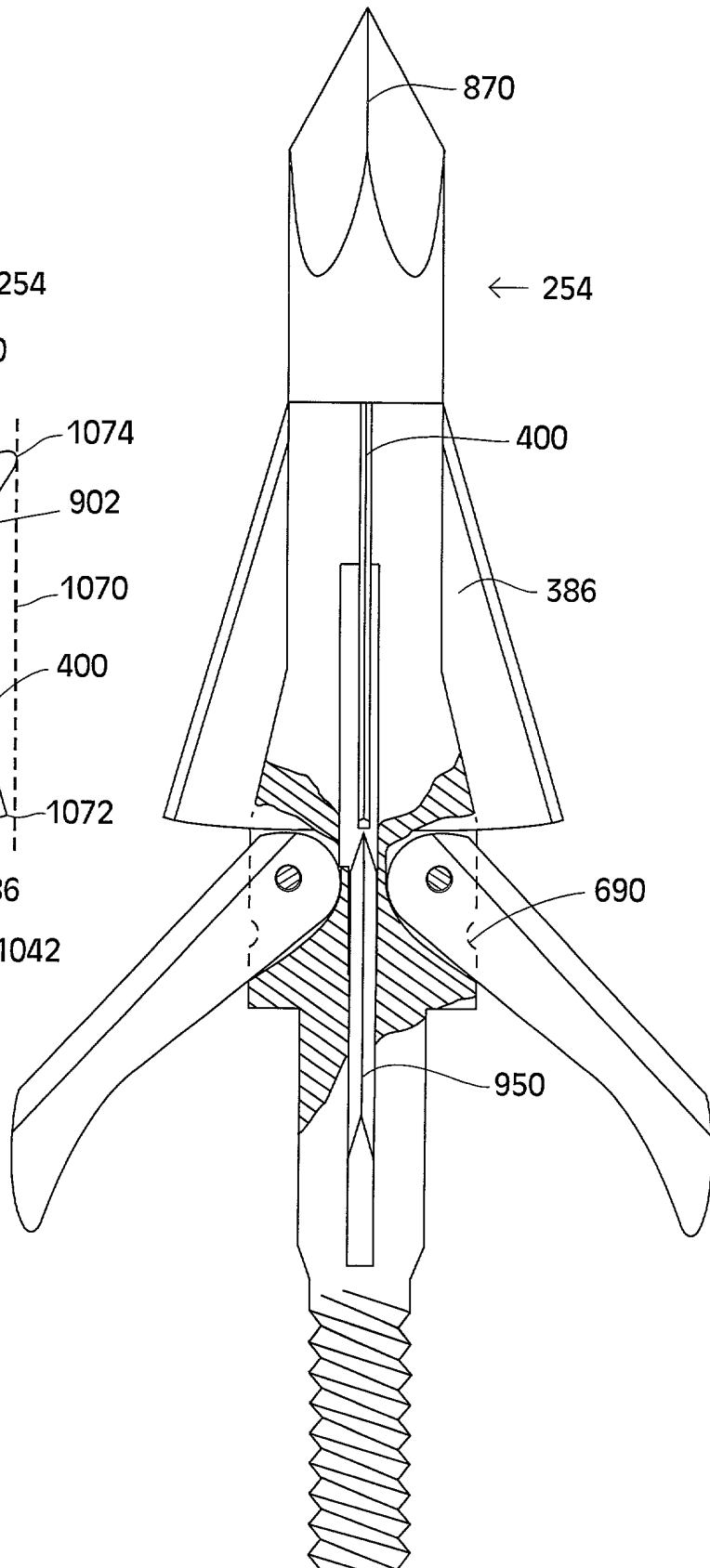


FIG. 147

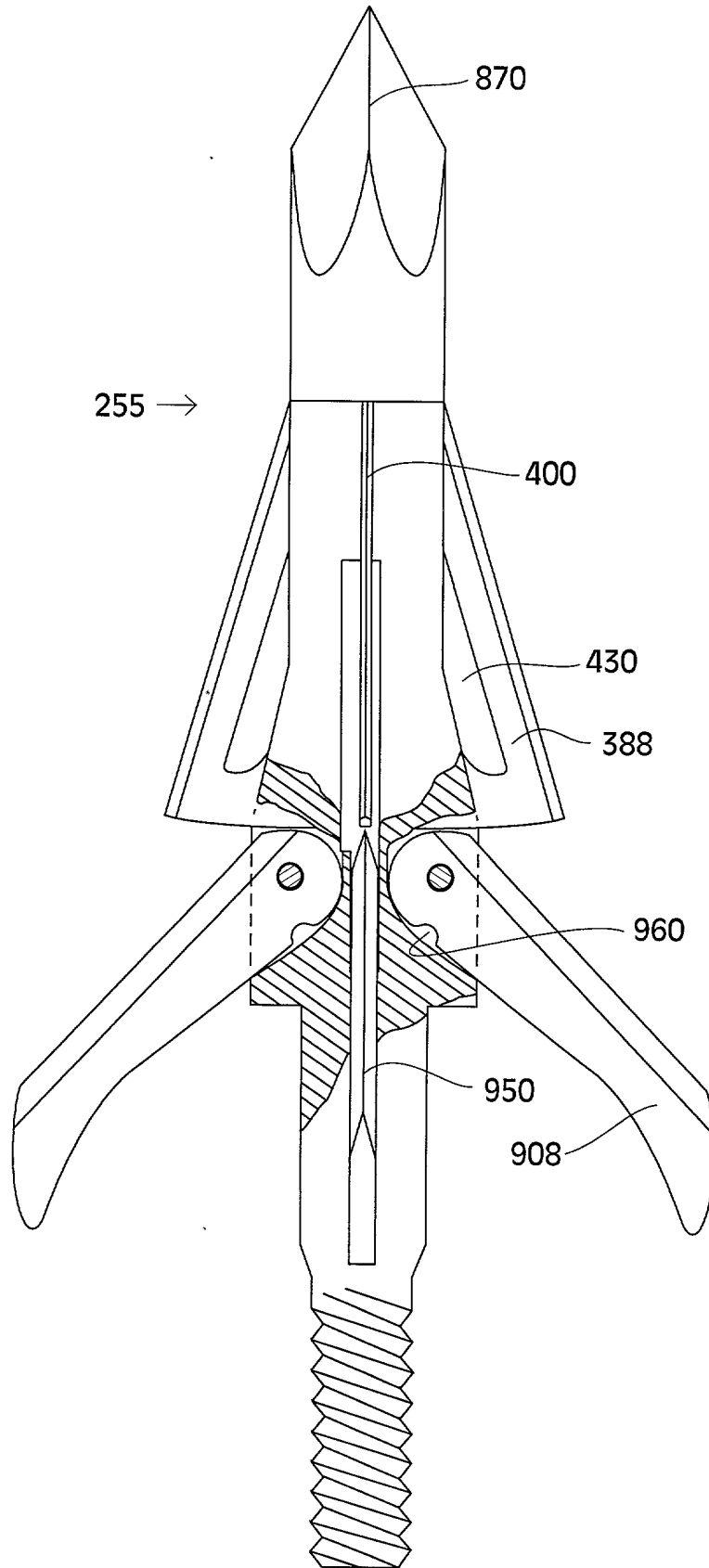
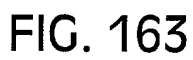
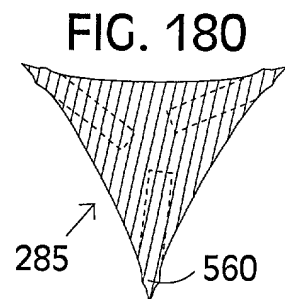
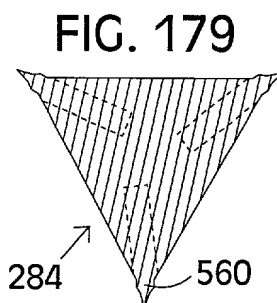
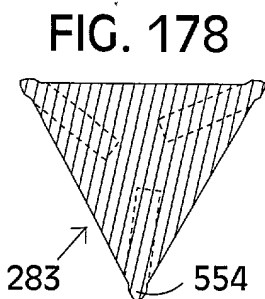
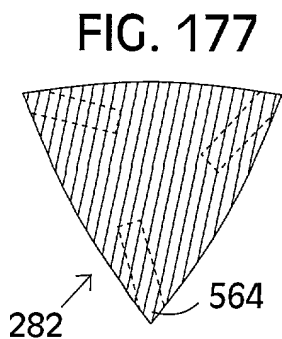
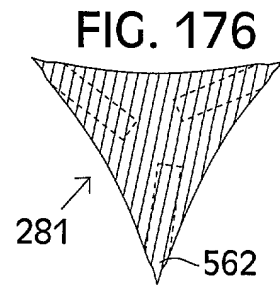
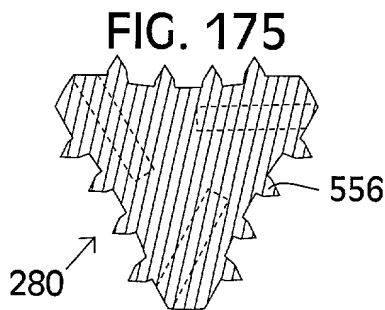
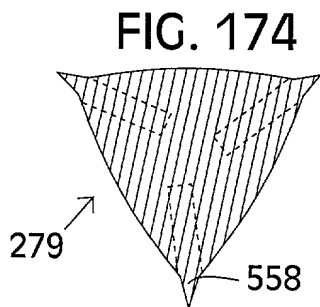
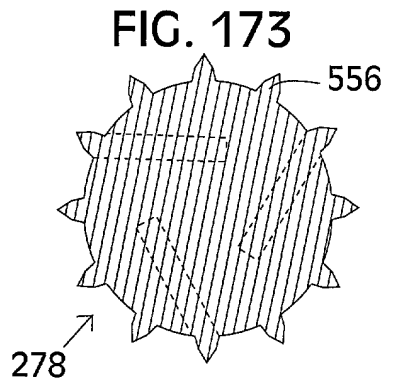
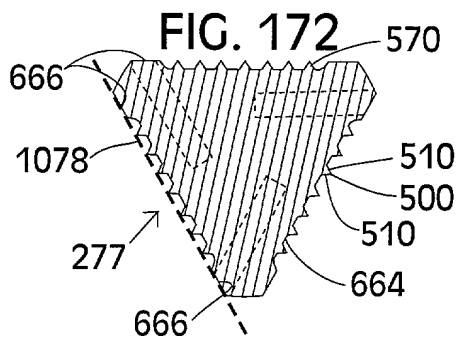
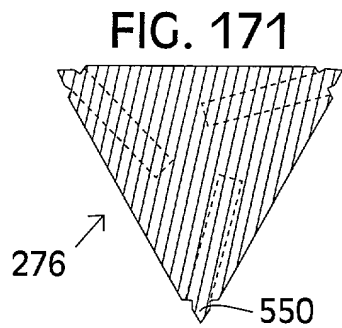
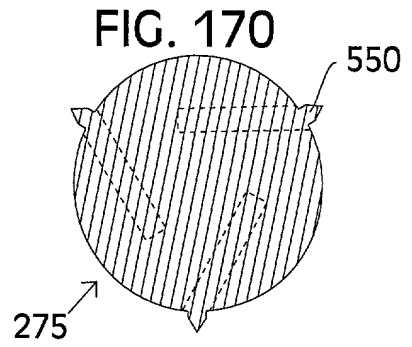
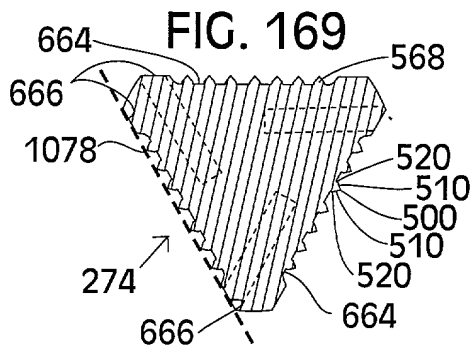
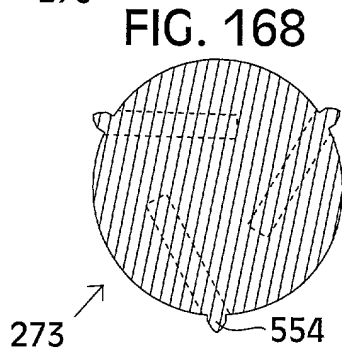
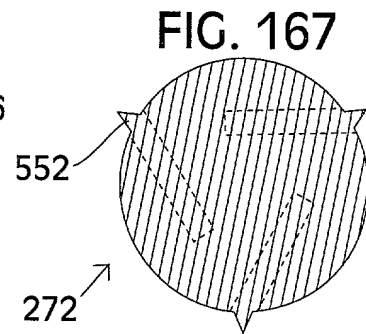
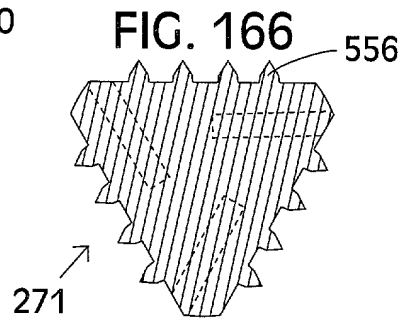
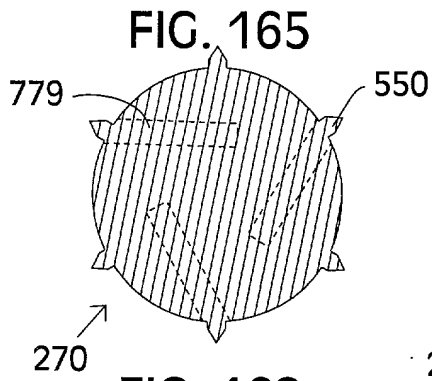


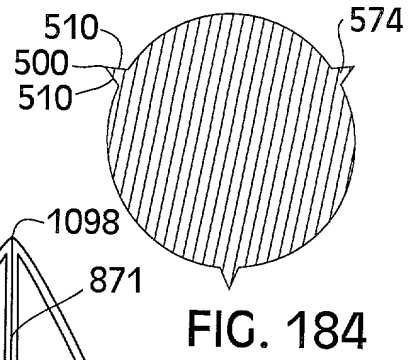
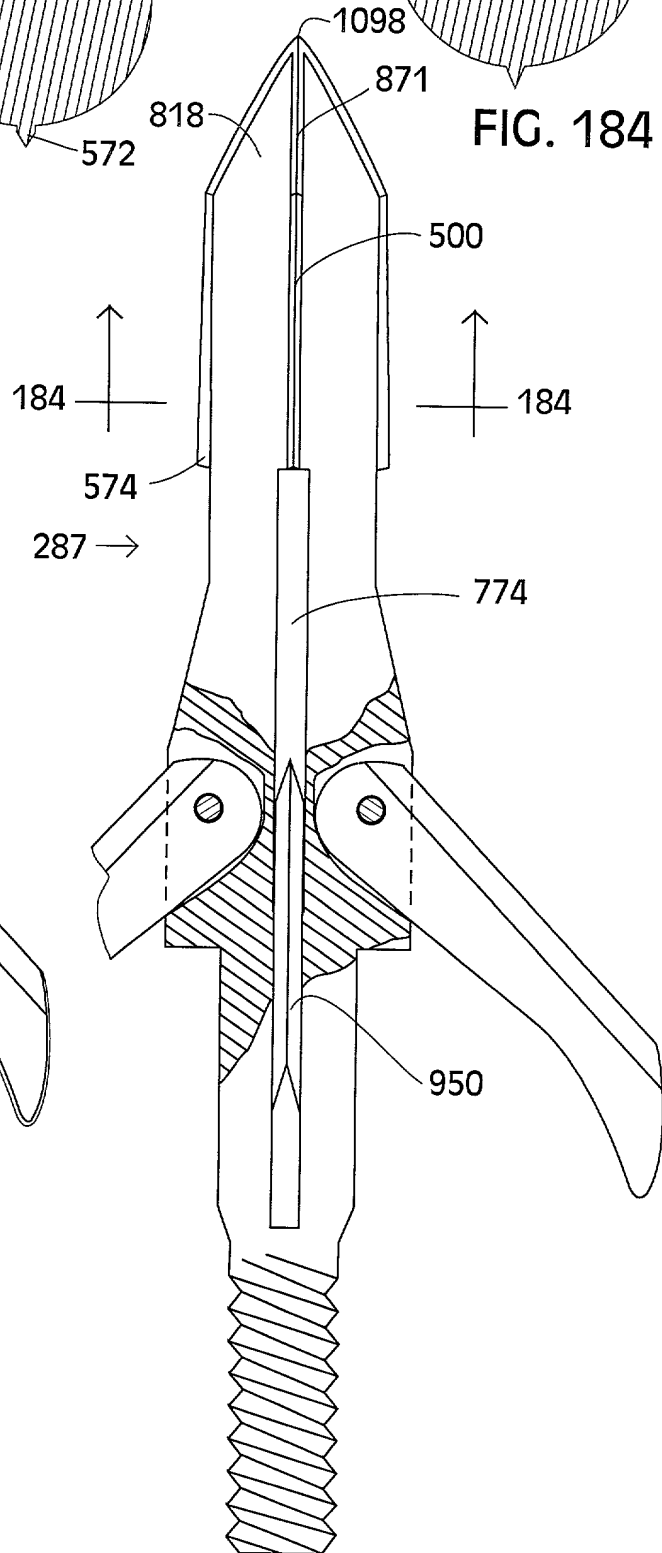
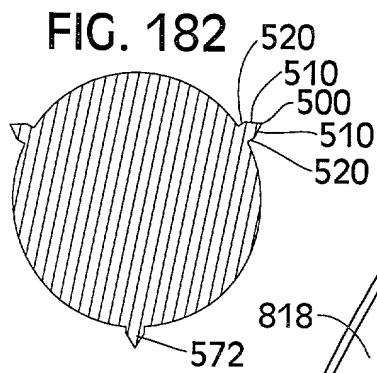
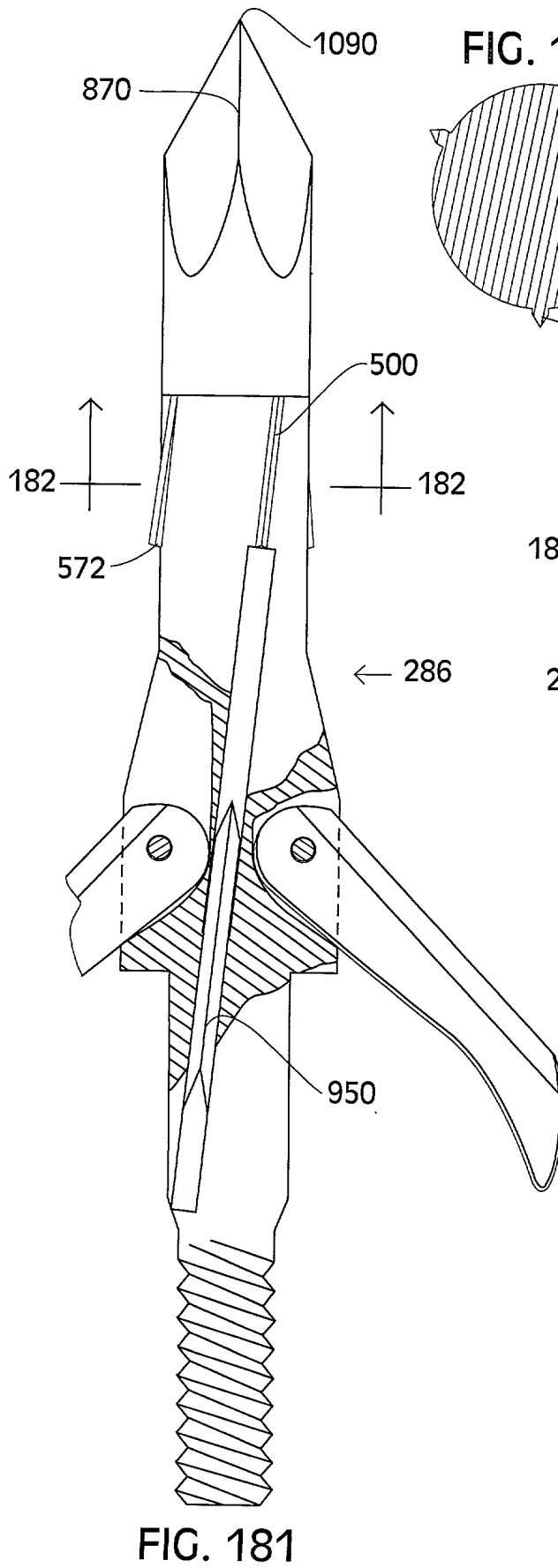
FIG. 148

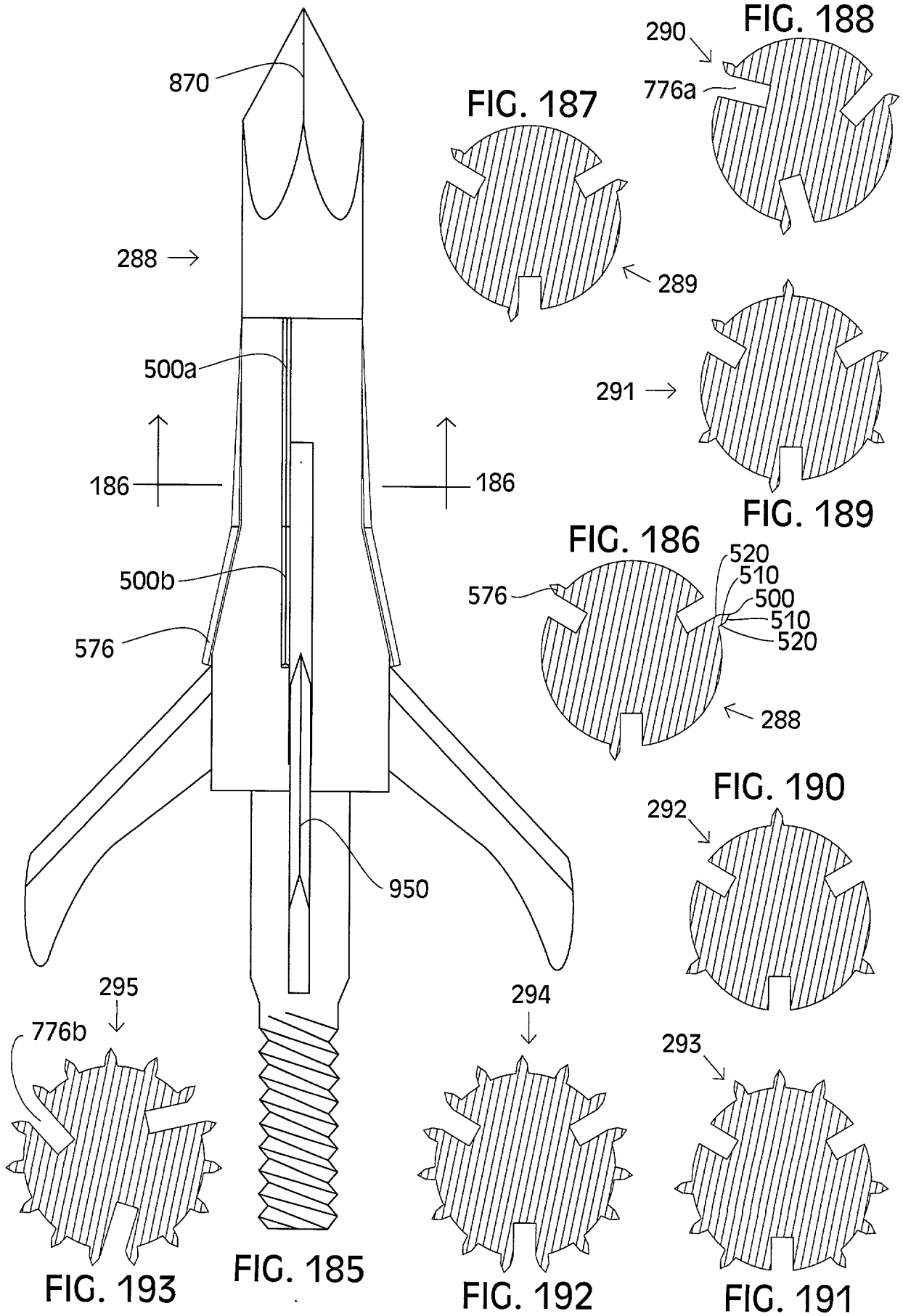












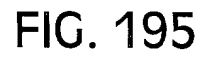


FIG. 194

## DECLARATION FOR PATENT APPLICATION

Docket Number (Optional)

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled Penetration Enhancing Aerodynamically Favorable Arrowhead, the specification of which

is attached hereto unless the following box is checked:

☐ was filed on \_\_\_\_\_ as United States Application Number or PCT International Application Number \_\_\_\_\_ and was amended on \_\_\_\_\_ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR § 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. § 119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Priority Not Claimed

Prior Foreign Application(s)

_____ (Number)	_____ (Country)	_____ (Day/Month/Year Filed)
_____ (Number)	_____ (Country)	_____ (Day/Month/Year Filed)

☐

☐

I hereby claim the benefit under 35 U.S.C. § 119(e) of any United States provisional application(s) listed below.

\_\_\_\_\_  
(Application Number) \_\_\_\_\_  
(Filing Date)

\_\_\_\_\_  
(Application Number) \_\_\_\_\_  
(Filing Date)

I hereby claim the benefit under 35 U.S.C. § 120 of any United States application(s), or § 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. § 112,

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR § 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application.

\_\_\_\_\_  
(Application Number) \_\_\_\_\_  
(Filing Date) (Status -- patented, pending, abandoned)

\_\_\_\_\_  
(Application Number) \_\_\_\_\_  
(Filing Date) (Status -- patented, pending, abandoned)

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

N/A Applicant "Pro Se" Provo UT  
Address all telephone calls to \_\_\_\_\_ at telephone number (801)-374-1739  
Address all correspondence to \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first inventor (given name, family name) Victor Jay Liechty II

Inventor's signature Victor Jay Liechty II Date May 28, 1999

Residence 397 Magpie Rd Lyman WY 82937 Citizenship USA

Post Office Address 1250 N. 1750 W.

(Correspondence) Provo UT 84604

Full name of second joint inventor, if any (given name, family name) \_\_\_\_\_

Second inventor's signature \_\_\_\_\_ Date \_\_\_\_\_

Residence \_\_\_\_\_ Citizenship \_\_\_\_\_

Post Office Address \_\_\_\_\_

☐ Additional inventors are being named on separately numbered sheets attached hereto.